ME-7361

MDS®

4025 MAGNETIC TAPE DRIVES

TECHNICAL MANUAL

M-3027

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MOHAWK DATA SCIENCES CORP.
CORPORATE HEADQUARTERS, UTICA, NEW YORK 13503 • PHONE (315) 792-2222

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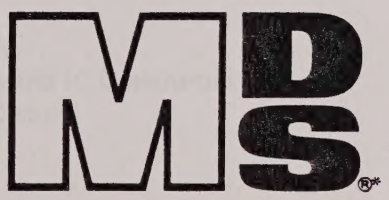

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SECTION I

DESCRIPTION

1.1 SCOPE

This manual covers Model 4025 Magnetic Tape Drives which are either 7- or 9-track, IBM-compatible tape transports designed for use in computer, communications, media conversion, and data acquisition applications. This manual contains the information required to install, operate, and maintain the Magnetic Tape Drives.

1.2 PHYSICAL DESCRIPTION

The Magnetic Tape Drive (hereinafter referred to as the MTD) covered in this manual is illustrated in Figure 1-1. The Model 4025 MTD has a tape speed of 75 or 125 ips,with a rewind speed of 480 ips. The MTD is available in either or both NRZI and PE configurations, depending on customer specifications.

The MTD's provide for completely automatic threading of any industry standard tape reel. In addition, they optionally provide for automatic loading of IBM wrap-around tape cartridges via the Easy Load I feature.

The tape path provided in the MTD transport provides an optimum configuration with the oxide side of the tape touching only the head and tape cleaner during data transfer operations. The tape is removed from the tape cleaner during rewind to minimize tape wear. Air bearings are utilized at tape turn-around points to eliminate lateral tape forces and reduce friction. A unique linear optical reel servo system ensures smooth, reliable, restriction-free performance.

All data electronics are packaged on printed circuit boards to provide quick modular service and replacement. The MTD uses DTL integrated circuit logic, silicon transistors, and linear integrated circuits to insure maximum electronic reliability.

The standard MTD consists of a complete transport, control electronics, power supplies, vacuum system and air system, read/write and erase head, and tape cleaner. The standard MTD also includes read/write data electronics, with associated input-output circuitry and controls. In addition, a self-test feature is provided which permits the MTD to be set-up and tested off-line.

The front of the MTD is illustrated in Figure 1-2. It is shown with the vacuum column cover door and dust cover opened. The control panel is mounted on the top right-side of the vacuum column cover door of the MTD. The front of the MTD contains the take-up reel, the supply reel, and the two vacuum columns. In addition, an interlock switch is located on the front of the MTD. The interlock switch will cause the MTD to halt operations if the dust cover is opened.

Figure 1-3 is a simplified view of the MTD showing the tape path. When a tape is to be threaded, air pressure forces the tape off the reel and into the upper threading chute. Air pressure guides the tape along the upper threading channel past a tape guide and the EOT/BOT sensor assembly. Adjacent to the EOT/BOT sensor assembly is the tape cleaner. After passing the tape cleaner assembly, the tape is threaded past the read/write and erase head.

The tape is then passed over a tape guide, through the lower threading channel, and routed to the take-up reel. Once the tape has been loaded, a tape threaded sensor on the take-up reel indicates that fact and causes the main vacuum system to become operative after the BOT is sensed. This causes both reels to feed tape into the vacuum tanks, over the two air bearings on the output of the supply tank, and between the capstan and in the take-up tank. Both tape guides are spring loaded to insure precise edge guidance for NRZI operation.

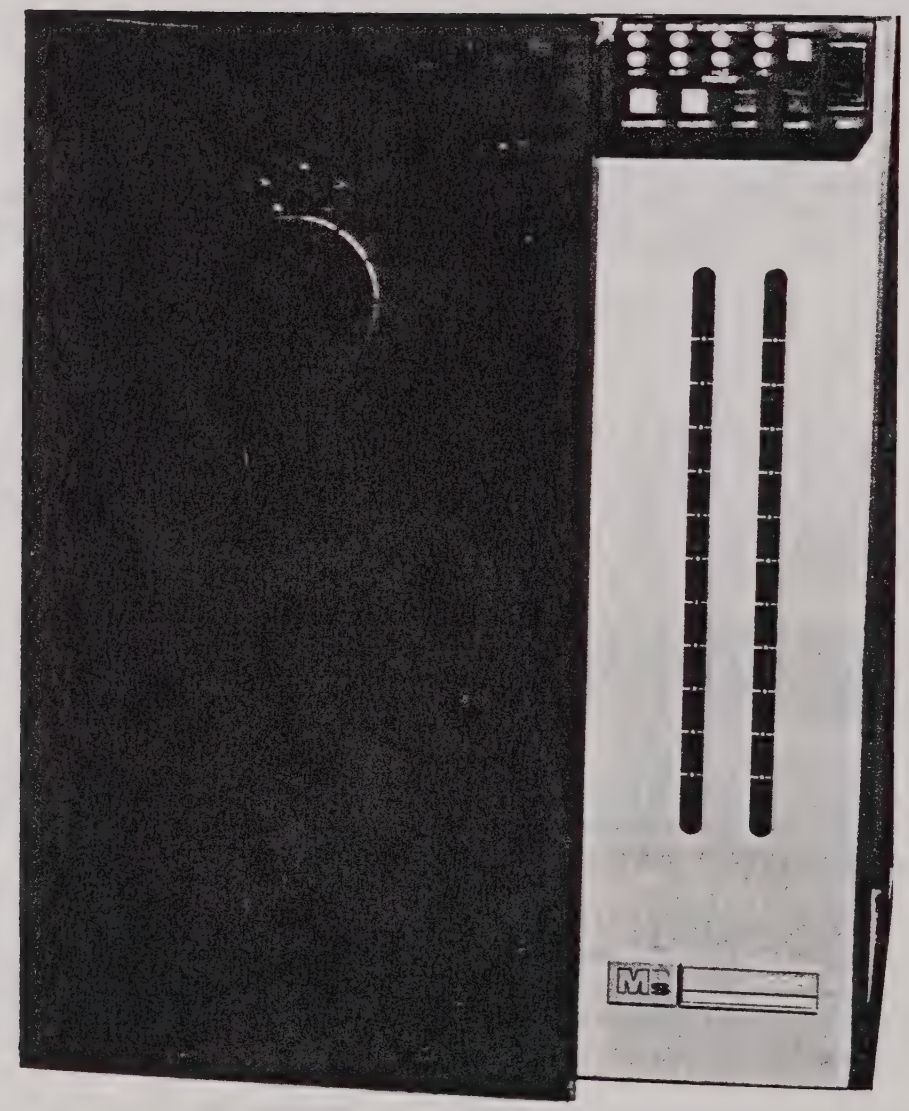

Figure 1-1. Magnetic Tape Drive, Model 4025

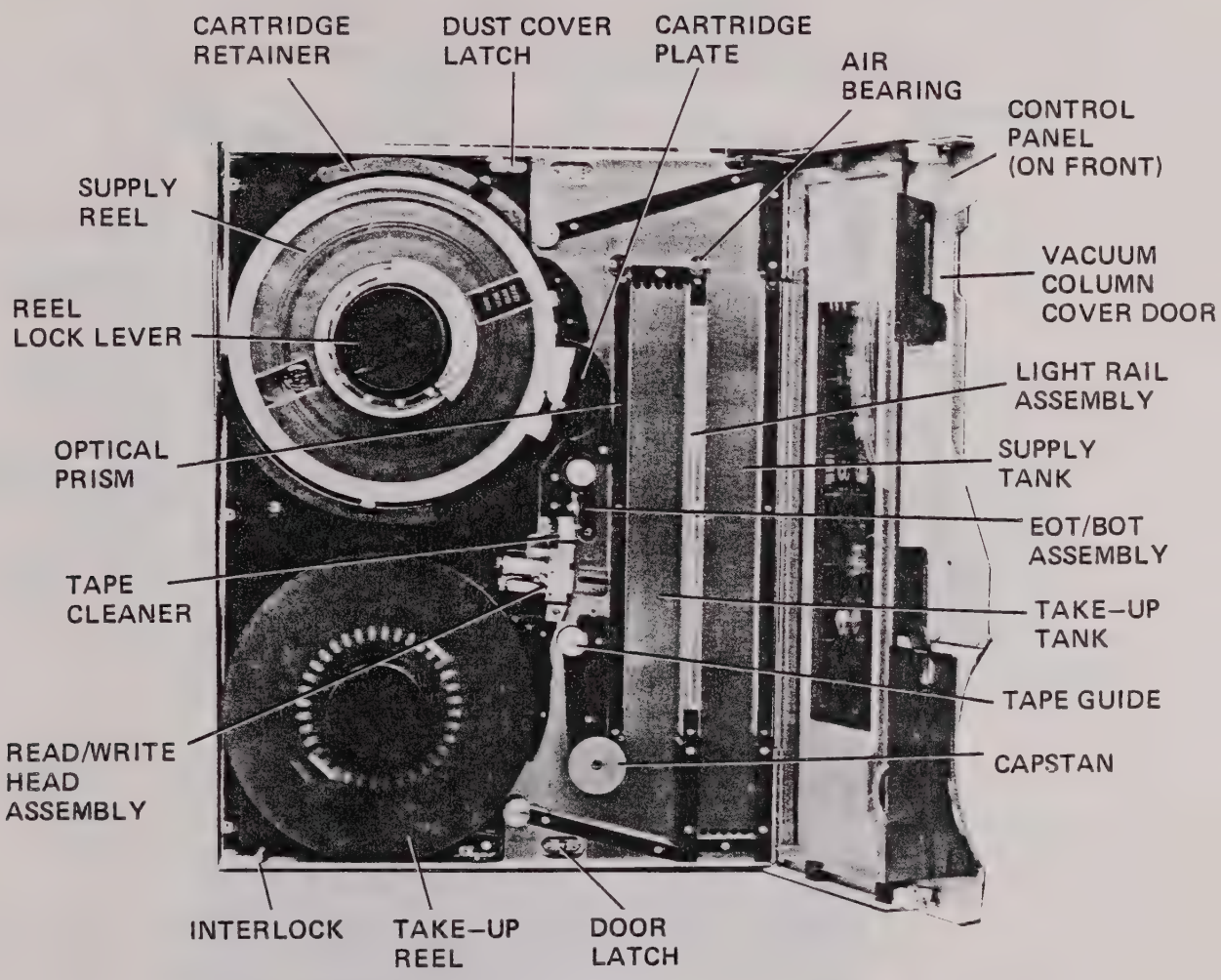

Figure 1-2. MTD, Vacuum Column Cover Door Open

At the rear of the MTD are two data connectors, a power connector and a main power circuit breaker. The second data connector is used for either a terminator or daisy chain connection.

The interior of the MTD is accessible for maintenance by swinging out the front casting. Figure 1-4 is a rear view of this casting. Mounted to this frame are the supply and take-up reel motors, the capstan motor, the cartridge motor (if Easy Load I feature is on MTD) and the electronics module assembly containing five logic PC boards. In addition, the transport (P55) and I/O (P59) connectors are plugged into the electronics module. The transfer valve and air solenoid, which control air flow for both threading and normal tape operations, are also located on this casting.

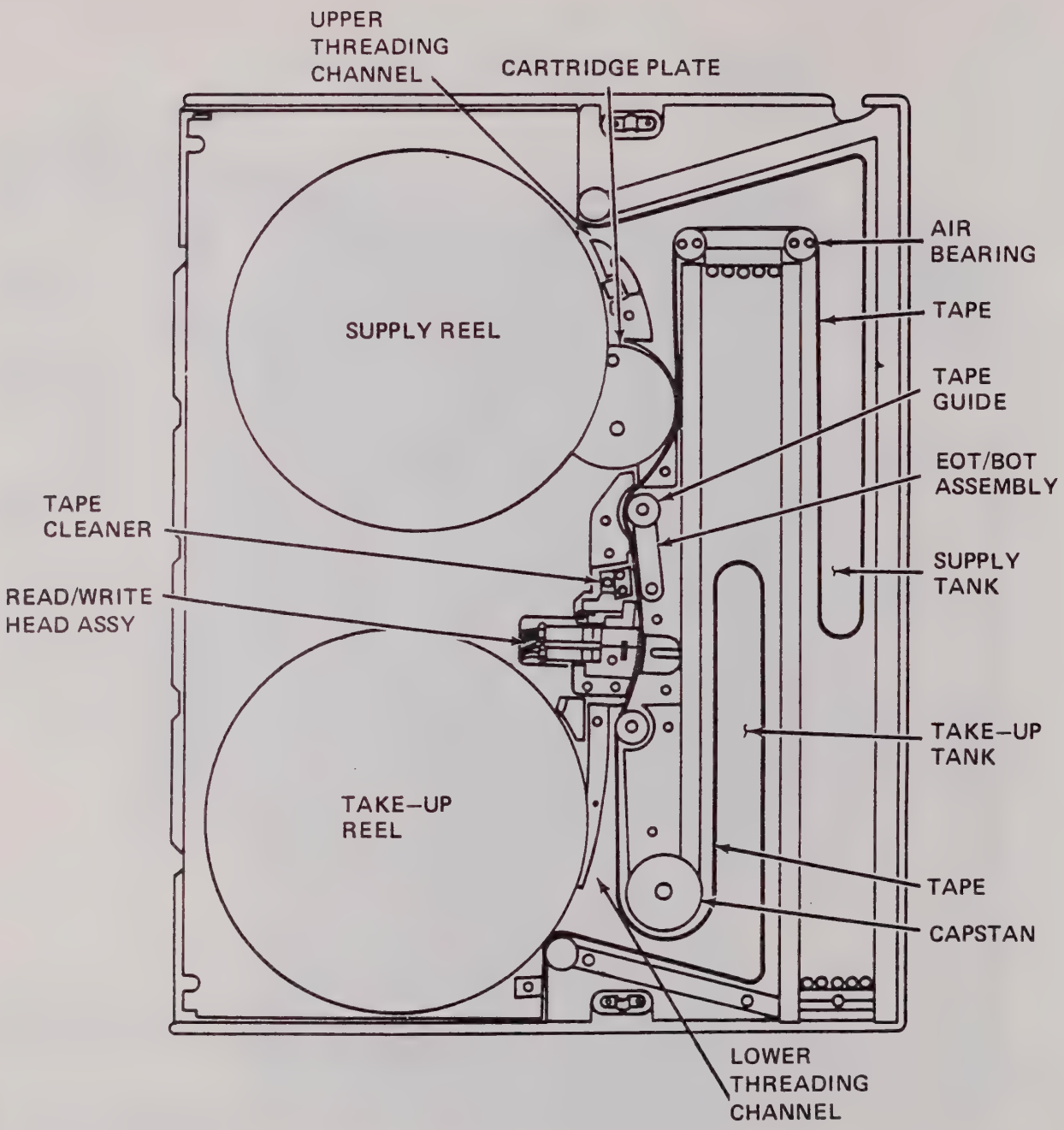

Figure 1-3. Tape Path

With the MTD's front casting opened, access is provided to the chassis interior, as illustrated in Figure 1-5. The chassis interior contains the pneumatic supply assembly, cooling fans, servo capstan control A3, regulator A2, and power supply A1. The servo capstan control module swings down to expose regulator A2. Regulator A2, in turn, swings down to expose power supply A1.

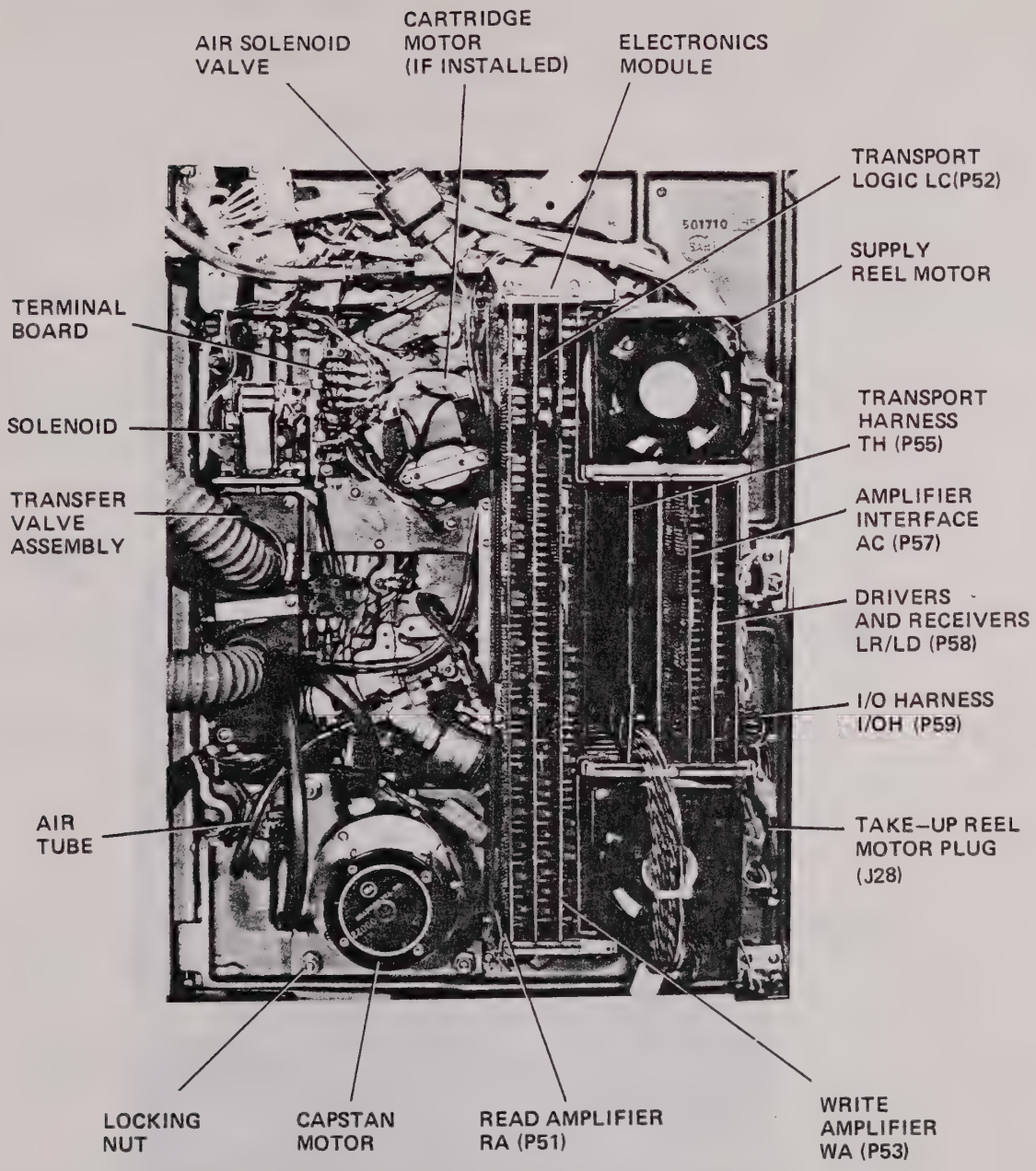

Figure 1-4. MTD Front Casting (Rear View)

1.3 INTERFACE SPECIFICATIONS

The logic levels for the MTD are as follows:

INPUT			OUTPUT		
Logical '1'	True	= 0 vdc (.8v max.)	Logical '1'	True	= 0 vdc (.8v max.)
Logical '0'	False	= +3 vdc (+2.4v min.)	Logical '0'	False	= +3 vdc (+2.4v min.)

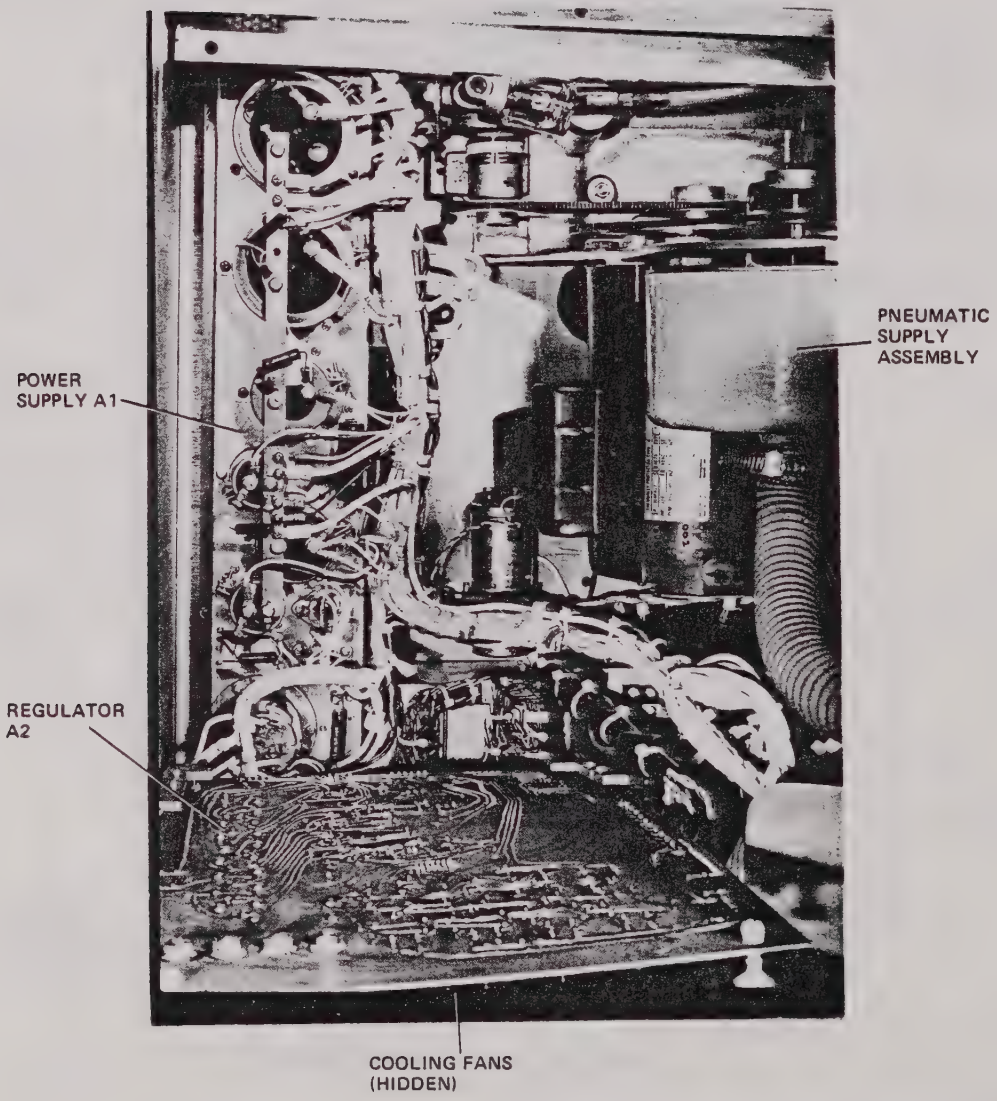

Figure 1-5. MTD Chassis Interior

1.4 PERFORMANCE CHARACTERISTICS

Table 1-1. MTD Performance Characteristics

Category	Operational Specification
Speed	75 or 125 ips
Tape	1/2 inch, 1.5 mil IBM Dynexcel, Series 500 or equivalent
Reel Size	Industry standard reels of 10.5 inches, 8.5 inches, or Mini-Reel. Optionally, IBM wrap-around tape cartridges may be used with any 10.5 inch reel if Easy Load I feature is installed.
Tape Loading Time	Approximately 10 seconds
Recording Density	200, 556, 800 bpi NRZI 1600 bpi phase encoded 800/1600 bpi dual density
Recording Format	9-track, 0.6-inch IRG, standard 7-track, 0.75-inch IRG, optional
Read/Write Gap Spacing	9-track: 0.150 ±0.005 inch 7-track: 0.300 ±0.005 inch
Start/Stop Times	Guaranteed to be IBM compatible (specific figures are a function of tape speed).
Speed Variation	±2 per cent
Rewind Speed	480 ips Nominal
Power Input	
Voltage/Freq.	115/208/220/230 volts +10% - 7%, 50 or 60 Hz, ±1 Hz, single phase.
Current	40 Amp surge @ 115 VAC for 5 sec. 15 Amp @ 115 VAC worst case peak operating.

Physical Statistics and Environmental Requirements

	Operating	Non-Operating
Room Temperature	60 to 90° F (18 to 32° C)	-30 to +150° F (-34 to 66° C)
Relative Humidity	30 to 80 percent	5 to 95 percent
Maximum Wet Bulb	78° F (23° C)	80° F (24° C)
Dimensions		
Height	24.5 in. (63 cm.)	
Width	19 in. (48 cm.)	
Depth	19 in. (48 cm.)	
Weight	230 lbs. (105 kgrm.) Approximately	

SECTION II

THEORY OF OPERATION

2.1 GENERAL

2.1.1 This section provides a complete description of the theory of operation of the MTD. Since all MTD systems covered by this instruction book have basically the same components and electronics, only one description is presented. Included also are block diagram descriptions and detailed circuit analysis.

2.2 SYSTEM APPLICATION

2.2.1 Up to eight MTD units may be used by one remote computer or control device. The process by which this may be accomplished is called "daisy-chaining." A particular MTD is selected by rotating eight selected cables in the daisy-chain as shown in Figure 2-1.

2.2.2 The eight "select" lines are routed from the computer to the I/O cable card in the first MTD (MTD 0). The first of these lines, CUST ADD SEL LINE 0 is applied from the cable card to the control circuits in the MTD so that if that select line is a ONE, MTD 0 is activated and processes data from the remote device. If that select line is a ZERO, MTD 0 remains inactive.

2.2.3 The seven remaining "select" lines are connected in parallel to a second transport cable card in MTD 0. This card is in turn connected to the input transport cable card in MTD 1. However, as illustrated in Figure 2-1, the CUST ADD SEL LINE 1 line is applied to the control circuits in MTD 1. In this case, only if the CUST ADD SEL LINE 1 line is activated will MTD 1 be able to process data.

2.2.4 This method of cable rotation may be used to daisy-chain up to eight MTD units to a single tape control unit with each unit being uniquely selected by activating its associated select line.

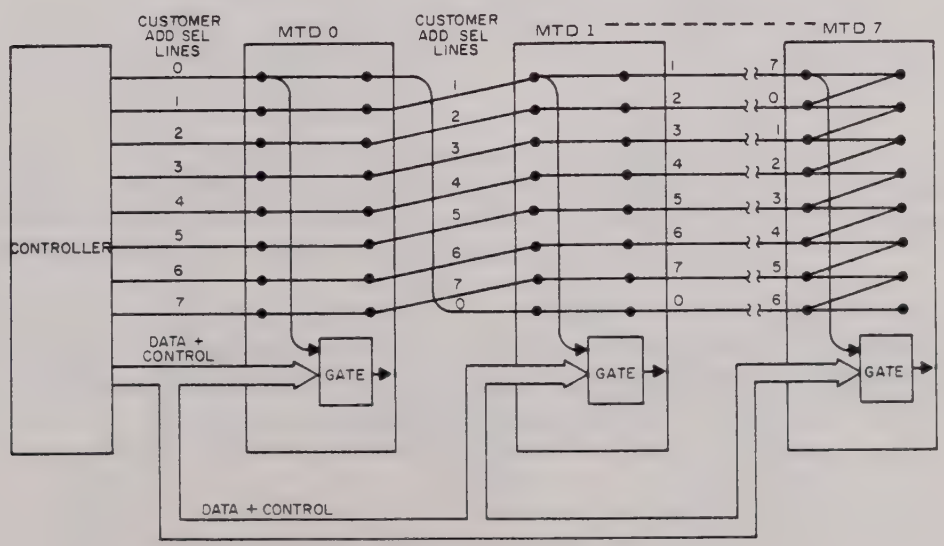

Figure 2-1. MTD Selection by Rotation of Cables

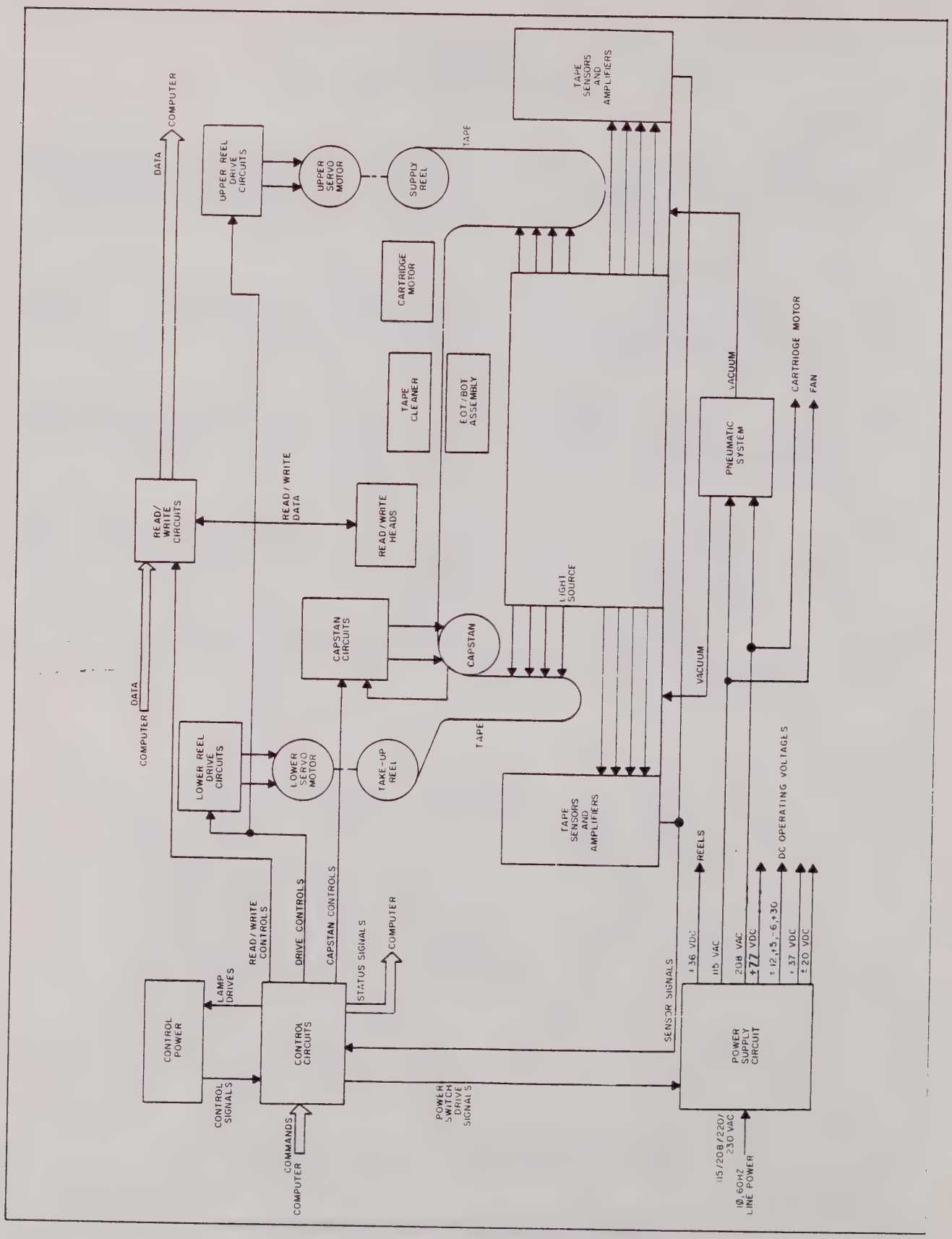

Figure 2-2. MTD, Overall Block Diagram

2.3 OVERALL FUNCTIONAL DESCRIPTION

2.3.1 The MTD basically consists of tape transport, control panel, control circuits, read/write circuits, reel servo system, capstan servo system, power supply circuits, and pneumatic system, as illustrated in the block diagram of Figure 2-2.

2.3.2 To load a tape without a cartridge, the operator depresses the LOAD/RWD switch on the control panel which causes a control signal to be generated to the control circuits. The control circuits then generate drive signals to the solid state power switches which control application of motor power. This causes power to be applied to the vacuum motor and transfer valve solenoid in the pneumatic system.

2.3.3 The control circuits also generate control signals to the reel servo amplifiers so that the tape may be automatically threaded from the supply reel to the take-up reel. The control circuits cause the cycle to be aborted if the tape does not thread past the BOT/EOT Sensor assembly within 1-1/2 seconds after threading. If the tape does thread properly, the cycle proceeds until the tape threaded sensor detects the fact that the tape is on the take-up reel. Again, the control circuits abort the cycle if this event does not happen within the alotted time.

2.3.4 Tape is then taken up on the take-up reel until the beginning-of-tape (BOT) marker on the tape is detected by the EOT/BOT assembly. The control circuits abort the cycle if this event does not occur in 10 seconds. After the BOT marker is detected, the control circuits generate a drive signal to a solid-state power switch which causes power to be removed from the transfer valve in the pneumatic system. Vacuum is removed from the threading channels and applied to the vacuum tanks at this time. Air bearing pressure is also applied.

2.3.5 The control circuits then check that the vacuum pressure is sufficient. If the vacuum is adequate, the vacuum switch closes and the reels feed the tape into the two vacuum columns. The transport sensors in the vacuum columns then send signals to the control circuits which indicate that the tape is in the columns.

2.3.6 Once the tape is in the columns, the control circuits cause the MTD to go into a normal servo power status. A reverse command is initiated and the tape is then run in reverse back to the BOT marker. The MTD is now ready for normal operation and may be turned over to remote operation by depressing the START pushbutton on the control panel.

2.3.7 If the supply tape reel is equipped with a cartridge, depressing a control panel push-button causes the control circuits to generate a drive signal to a solid-state power switch which then applies power to the cartridge motor for purposes of opening the cartridge. Power is also applied to the vacuum motor as described previously. The MTD then attempts to thread the tape.

2.3.8 The MTD looks for the tape threaded sensor signal indicating that the tape has been threaded on the take-up reel within 2-1/2 seconds. If this time check fails, a second attempt is made to thread the tape. Again, a second failure causes the cycle to be aborted. If the tape is threaded on the take-up reel within the time limit, tape is then taken up until the BOT marker is detected. The remaining portion of the loading cycle is the same as described for loading a tape without a cartridge.

2.3.9 Unloading a tape is also accomplished from the control panel. The RESET pushbutton is depressed to return MTD control to the operator. Depressing the UNLOAD pushbutton causes generation of a control signal to the control circuits. The control circuits then cause the capstan system and reel servo amplifier to enter a rewind operation. The tape rewinds at high speed until the low tape sensor detects light as a result of the tape supply on the take-up reel falling below an established level. The tape is then decelerated to normal reverse speed until the BOT marker is detected. The MTD is then switched from normal power status to low power status on the reel servo. The supply reel takes up tape until the tape comes out of both vacuum columns. To prevent tape stretching, the take-up reel also begins to rotate. The supply reel continues to take up until the broken signal is detected by the control circuits. A time-out occurs, and the supply reel then continues to take up the remainder of the tape into the cartridge and then stops. At this time, the cartridge motor causes the cartridge to be closed.

2.3.10 Once a tape has been threaded by depressing the LOAD/RWD switch, followed by successful threading of the tape, control of the MTD is ready to be turned over to the computer. This is accomplished by the operator depressing the START switch on the control panel. This causes generation of a control signal to the control circuits which, in turn, place the MTD in a ready mode. If the START switch on the control panel has been depressed and if the MTD is selected by the select lines from the computer, the MTD control circuits may now react to motion control commands from the computer. Based on these commands, the control circuits apply the appropriate forward or reverse motion signals to the capstan system and to the reel servo amplifiers. These circuits drive the capstan motor and reel servo motors thereby controlling tape motion. Feedback is used to stabilize capstan motion.

2.3.11 The computer also provides nine data lines to the write amplifiers. These nine data lines contain the data to be written on tape. These data are written on the tape when the MTD has been placed in a writing status by the CUST SET WR STAT command if the supply reel is equipped with a Write Enable ring. When this ring is installed, it causes a switch on the transport to engage which, in turn, sends +30 volts to the write and erase circuits thereby enabling write and erase currents to flow in the write and erase heads. The write amplifiers apply the data to the write head which writes the data on tape.

2.3.12 The write amplifiers are capable of writing either phase-encoded (PE) data or non-return to zero (NRZI) data. In PE recording of data, a ONE or ZERO is written on tape as determined by the direction of the flux lines in the middle of the bit cell. If the flux is opposite the reference, a ONE is written on tape; if the flux is the same as the reference, a ZERO is written on tape. In NRZI recording of data, a ONE is written on tape as a transition while a ZERO is written by the absence of a transition.

2.3.13 In the read mode, the data read from the tape by the read head are applied in parallel to the read amplifiers. These circuits amplify and shape the data, convert them to digital signals and send these data to the computer over nine parallel lines. The data may be PE data, NRZI data, or both, depending on customer requirements.

2.3.14 The power is supplied from the power supply circuits. The power supply circuits are powered from either a 115-, 208-, 220-, or 230-volt AC, single-phase, 60-Hz power source. The input power is transformed, rectified, and series regulated to provide the DC operating voltages for the MTD, that is: ±36 VDC, +30 VDC, +77 VDC, +37 VDC, ±20 VDC, ±12 VDC, +5 VDC, and -6 VDC. In addition, the AC voltages required to operate the pneumatic system motor, cooling fan, and cartridge motor are also generated by the power supply.

2.4 DRAWINGS, SIGNAL MNEMONICS, AND IC DESIGNATORS

2.4.1 In the detailed descriptions of the various MTD circuits provided in the remainder of this section, references are made to logic and schematic diagrams. The logic diagrams have been prepared from a functional standpoint, while the schematic diagrams represent the circuitry physically contained on each circuit board. The logic diagrams are assigned 4-digit numbers starting at 0100, and are arranged in numerical order. A text reference to one of the logic diagrams would, therefore have the form

(0410)

2.4.2 The schematic diagrams are not included in this manual, but are shipped with the unit under separate cover.

2.4.3 Since abbreviated signal names are used throughout the text and diagrams of this technical manual, a complete signal list is also given starting on page 2-41.

2.4.4 In order to easily identify a particular gate within an integrated circuit, the following convention is used throughout the text. First, the integrated circuit which contains the gate is identified by IC number, for example, 236. Next, the output pin of the IC which corresponds to the gate is added to the IC number, and after a dash, for example, 236-8. Gate 236-8, therefore, designates the gate within 236 whose output is at pin 8 of that IC.

2.4.5 On the logic diagrams, the pin number information adjacent to the symbol is the IC pin number. Card connector pin information is shown in the signal line in the form J/P53-30 which indicates that the signal is brought out of pin 30 of the PC assembly unit which plugs into J/P53. The symbol convention used inside the IC symbol is a letter or letters identifying the type of function, a three digit number identifying the IC location on the card, and the card number.

2.4.6 On non-digital symbols, the discrete components are listed in the symbol. The function symbols and PCB's used in the logic diagrams are summarized on the first logic diagram (0100).

2.4.7 As an example of this convention, consider three lines of data within a logic symbol which might appear as follows:

I

326

LC

The first line indicates that the circuit is an inverter. The second line indicates that the inverter is contained in 326, and the third line indicates that the IC in question is located on card LC which is the Transport Logic Control PCB.

2.5 CONTROL PANEL AND CONTROL CIRCUITS

2.5.1 GENERAL. The control panel and control circuits consists of seven functional circuits plus several switches and indicators as illustrated in figure 2-3. The following paragraphs contain a block diagram description of the control panel and control circuits, followed by detailed logic descriptions of each of the seven functional circuits which comprise the control panel and control circuits. The numbers in parentheses within the blocks refer to the corresponding logic diagrams. In the case of the motion control circuits, a further block diagram breakdown is provided in Figure 2-4.

2.6 BLOCK DIAGRAM DESCRIPTION

2.6.1 Figure 2-3 is a block diagram of the control panel and control circuits. This circuit controls the operation of the MTD in all of its operating modes, that is, tape threading, tape unloading, and remote operation under control of the computer.

2.6.2 When a tape without a cartridge is to be loaded, the operator depresses the LOAD/RWD switch on the control panel which generates a LOAD/RWD signal to the motion control circuits. These circuits then generate a LOAD signal to the motor control circuits to turn on the vacuum motor, and start the lower reel turning. After a delay to permit loading vacuum and air pressure to build up, the motion control circuits go into a threading mode for the tape to be threaded from the supply reel to the take-up reel by generating the take-up reel motor drive signals to the reel drive circuits.

2.6.3 The motion control circuits then check the time required to thread past the BOT/EOT sensor assembly. This is accomplished using the BROKEN TAPE SIG signal which is derived from the BOT SIG and EOT SIG signals from the tape sensors. The BROKEN TAPE SIG signal is active as long as the tape has not passed the EOT/BOT assembly. The cycle is aborted if the BROKEN TAPE SIG signal is not lost within 1-1/2 seconds. The circuit then checks to determine if the tape is threaded properly. This is accomplished by the tape sensor circuits generating a TAPE ON REEL signal when the tape is threaded. The cycle is aborted if the tape is not threaded within 2-1/2 seconds after the supply reel turns.

2.6.4 The tape is then taken up on the reel until the BOT marker is detected. Once the BOT is detected, the COL VAC signal is generated to the motor control circuits which causes the vacuum to be switched into the main vacuum columns. The motion control circuits and the master reset circuit then check to determine that the vacuum builds up to the proper level. This is accomplished by the vacuum pressure switch S8 generating the VAC SW signal to the master reset circuit. If the pressure does not build up within 2 seconds, a gate will set the load check flip-flop, which in turn produces the MAS RESET signal to the motion control circuits. The motion control circuits then abort the cycle.

2.6.5 The main pressure creates a vacuum in the tank columns which draws the tape into the columns. Tank sensor signals from the tape sensors signal the motion control circuits when the tape has entered the tanks.

2.6.6 Once the tape is in the tanks, the MTD is placed into a normal power reel drive status by generating TU and SUP MTR NORM POWER signals to the reel drive circuit. When the reels have positioned the tape loops in the center of the columns, a servo at null signal is generated. The motion control circuit then generates a REVERSE TO BOT signal to the capstan circuits to place the MTD into a reverse run operation. The MTD will then run in reverse at normal speed until the BOT signal is active indicating that the BOT marker is over the EOT BOT assembly. The MTD then stops and the motion control circuits generate a ready signal which lights the READY indicator on the control panel, and causes a CUST RDY status signal to be fed via the line drivers to the computer.

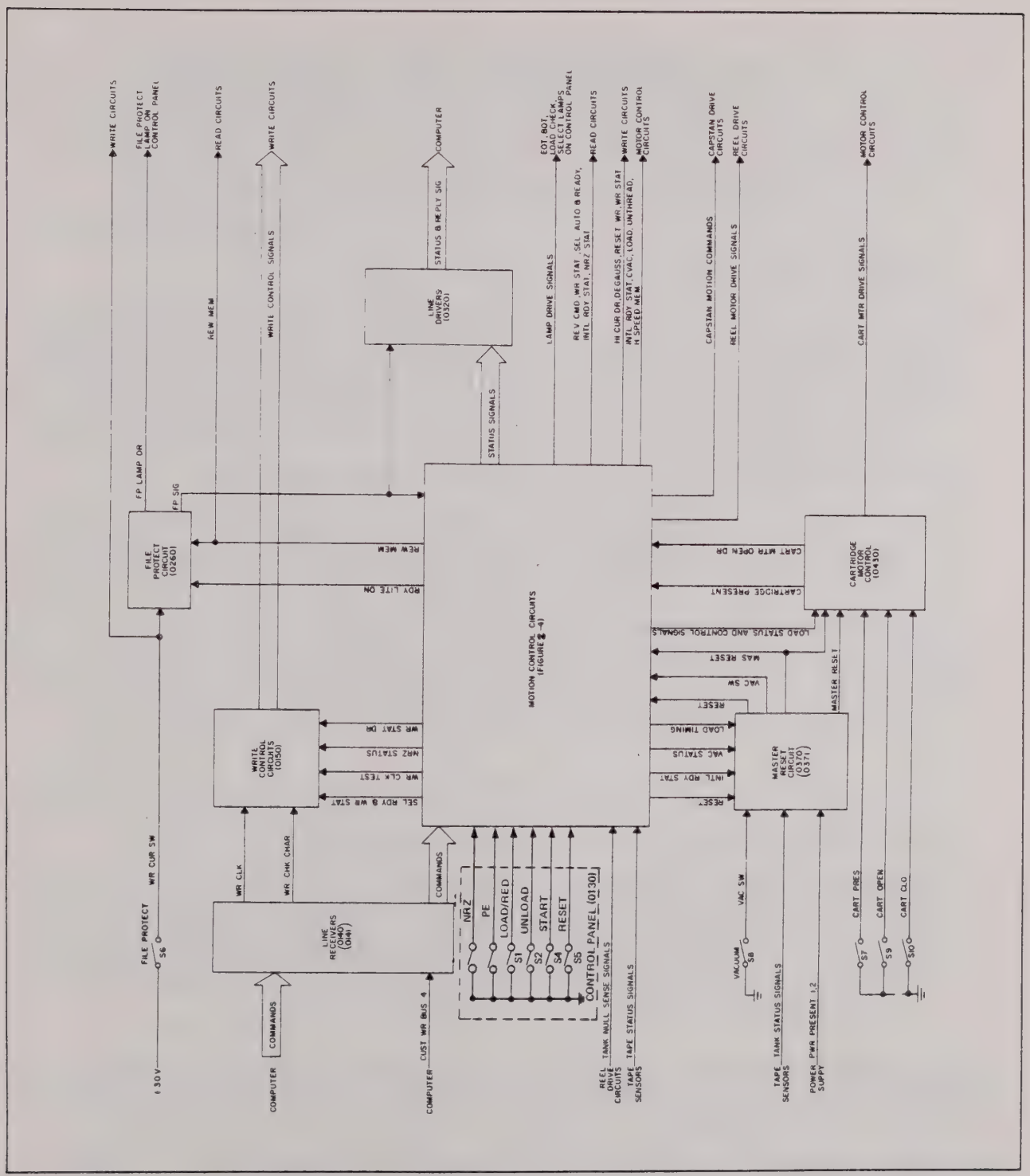

Figure 2-3. Control Panel and Control Circuits, Block Diagram

2.6.7 When the tape is equipped with a cartridge, the operation of threading the tape is similar except that load status and control signals are generated to the cartridge motor control to open the cartridge before an attempt is made at threading the tape. The cartridge motor control generates a CART MTR DRIVE signal to the cartridge motor for opening the cartridge. Once the cartridge is opened, the circuit begins threading operations. The threading operations are similar to those described previously except that two automatic attempts are made at threading. If the first threading attempt results in failure, the machine backs up for three seconds and makes another attempt. This is accomplished in the motion control circuits using the load check circuits. A failure on the retry causes 3-second back-up, and then aborts the cycle, lighting the load check indicator.

2.6.8 When unloading a tape, the process is initiated by the operator depressing the UNLOAD pushbutton on the control panel. This causes generation of a UNLOAD SW signal to the motion control circuits. The unthreading is performed by rewinding at high speed so that the REW H SPEED signal is sent to the capstan drive circuits and the reel drive circuit. When the rewind is complete, as indicated by a BOT signal from the tape sensors, the motion control circuits generate the supply reel and take-up reel unthreading commands to the reel drive circuit. Once the tape is unthreaded, the cartridge motor is then closed by a CART MTR CLO DRIVE signal from the cartridge motor control.

2.6.9 To turn control of the MTD over to the computer, the operator depresses the START pushbutton on the control panel. This causes generation of a START SW signal to the motion control circuits. The motion control circuits produce a RDY lamp signal which lights the ready lamp on the control panel and informs the computer via the line drivers that the MTD is ready for normal operation. This enables the receiving of computer commands for controlling MTD operation. The command or commands are processed and generate forward or reverse commands to the capstan and reel drive circuits to control tape movement. In addition, the motion control circuits generate MTD status signals to the computer, and also generate the read/write status to the read circuits, write control circuits, and capstan drive circuits. The write control circuits produce the various signals which direct the write operation.

2.6.10 The master reset circuit monitors the control signals from the motion control circuits, and the vacuum pressure switch. When a condition exists which is deemed an emergency, this circuit generates an MAS RESET signal to the motion control circuits to halt MTD operation.

2.6.11 Depressing the control panel RESET switch generates a RESET SW signal to the motion control circuits, and via these circuits to the master reset circuit. This signal, when applied to the motion control circuits, returns control of the MTD from the computer back to the MTD operator. In the master reset circuit, the RESET signal resets the flip-flop so that it is not in an error state if an error had previously existed. The RESET signal also places critical motion control circuits flip-flops into initial condition states for proper MTD cycling through subsequent operation.

2.6.12 Momentarily depressing the RESET switch during high speed rewind operations causes the MTD to slow down from high rewind speed to normal reversing speed. Depressing the switch again will cause the MTD to halt completely.

2.7 LINE RECEIVERS

2.7.1 The line receivers (0140 and 0141) receive the customer commands and write data bits from the computer in parallel. These signals are converted from computer logic levels to MTD logic levels by level changers and comparators within the line receivers. The comparator outputs are then inverted by inverter circuits to produce logic signals in MTD voltage levels. These signals are then applied to the write circuits, write control circuits, and motion control circuits, as applicable. Table 2-1 indicates the computer voltage levels at the line receiver inputs, and the MTD levels at the line receiver outputs.

Table 2-1. Interface Logic Voltage Levels

Logic Condition	Logic Voltage Levels
ONE or True	0.0V to 0.8V max.
ZERO or False	2.4V min. to 5.0V max.

2.8 FILE PROTECT CIRCUITS

2.8.1 The file protect circuits (0260) check to see whether a write enable ring is installed on the supply tape reel. If the supply reel does not contain a write enable ring, the tape is safe from erasure. In this case, file protect switch stays in its normally open (NO) position. No write current (WR CUR SW) is generated, and therefore the write and erase heads are inoperative. In addition, a ZERO - FP SIG is produced via inverters 718-10 and 718-8 which is fed to the write status, select, and ready circuits, and to the line drivers. This inhibits the write status flip-flop, and via the line drivers sends a CUST FP RPY signal to the computer, indicating that the supply reel on this MTD is file protected.

2.8.2 The -FP SIG is also applied to gate 614-12, enabling that gate and causing a ONE FP LAMP SIG to be applied to lamp driver Q1105. The lamp driver lights the FILE PROTECT lamp on the control panel. Gate 614-12 also receives the -REW MEM and RDY LITE ON signals from the rewind circuits and the write status, select, and ready circuits, respectively. Therefore, if the MTD is in rewind, or if the MTD is not ready, the FILE PROTECT lamp will be illuminated.

2.8.3 If the write enable ring is installed (the file is not protected), file protect switch S6 closes, applying a +30 volt potential to the WR CUR SW lines, generating a write current which enables the write and erase heads. The -FP SIG goes to ONE, allowing the write status flip-flop to set in the write status, select, and ready circuits, and removing the CUST FP RPY signal from the computer. If the MTD is not in rewind, or is in a ready condition, the FILE PROTECT lamp will not be lit when the file protect switch S6 is closed.

2.9 MOTION CONTROL CIRCUITS

2.9.1 The motion control circuits, figure 2-4, consist of the write status, select, and ready circuits, servo at null circuit, load circuits, unload circuits, rewind circuits, and the forward and reverse command circuit. These circuits are used to control tape motion under all operating modes of the MTD. The MTD operating modes are the load/rewind cycle, unload cycle, and remote operation. Each of these modes is described separately in the following paragraphs. Reference should be made to the block diagram of figure 2-4, as well as to the specifically referenced logic diagrams.

2.10 LOAD/REWIND CYCLE

2.10.1 The load cycle is a manually initiated cycle which is used to load a tape from the supply reel to the take-up reel. The supply reel may or may not be equipped with a cartridge. If the tape is already loaded, depressing the pushbutton causes the tape to rewind to the load point. If the tape is not loaded, depressing the pushbutton causes the MTD to automatically load the tape. There are two different loading cycles; one for a tape reel not equipped with a cartridge, and one for a tape reel equipped with a cartridge. Paragraph 2.11 describes the load portion of the cycle for a non-cartridge equipped reel, and paragraph 2.12 describes the differences between the load cycle using a cartridge and that without a cartridge and applies to MTD's with Easy Load 1 feature only.

2.11 LOAD CYCLE WITHOUT CARTRIDGE

2.11.1 To initiate a load/rewind cycle, the operator depresses the LOAD/RWD switch, S1, on the control panel. This generates a low -LOAD/REW signal which is applied to inverter 309-6 of the rewind circuits (0420). At this point, the MTD is not in a ready condition, and the -RDY LITE ON signal is high. Gate 304-8 is enabled, producing a low -LOAD/REW signal which is applied to inverter 709-10 in the load circuits (0400). The high output of 709-10 is applied to one input of gate 714-6. The second input to that gate is BROKEN TAPE SIG from the sensor amplifier. This signal is high if there is no tape across the EOT/BOT sensor assembly. Therefore gate 714-6 is enabled, producing a low -LOAD SET output which sets load flip-flop 714-11, 718-6. The load flip-flop remains set until the tape is loaded and rewound back to its BOT position, and the MTD is ready.

2.11.2 With the load flip-flop set, a high LOAD and a low -LOAD level is sent to the motor control (0440). The low -LOAD level is routed through gate 728-3 and inverter 723-8 to form the low -VAC MTR DR signal which activates power switch 640, Q151. This applies 115-volt AC1 power to the vacuum motor, causing it to operate. The -VAC MTR DR level is also applied via gate 613-8 and driver Q1123 to the reel servo circuit to energize the motor power relay.

2.11.3 At the same time, the high LOAD level is applied to one input of gate 723-6, whose other input, -COL VAC, is also high. Enabled gate 723-6 produces the low -TRANSFER VALVE DR level which activates power switch 648, Q451. This in turn applies 208 volt AC power to the transfer valve, operating that valve and causing the air pressure to be applied to the threading channel. With the pressure in the threading channel, tape is directed from the supply reel to the take-up reel. At this time there is no vacuum in the columns, and column vacuum flip-flop 608-6, 618-8 (0400) is not set. The output of 618-6 is therefore low, producing a high output from gate 613-11. This high is applied to one input of gate 714-3. The second input to 714-3 is the high LOAD level, and gate 714-3 is enabled. The low output of enabled gate 714-3 is inverted by 709-4 to form the high THREAD signal.

2.11.4 Gate 705-8 (0401) receives the high THREAD level plus the high -BACKUP level since the MDS is not unthreading at this time. The low output of 705-8 is the —THREAD TU MTR DR signal, which is applied to the reel drive circuits, causing the take-up reel motor to rotate at threading speed.

2.11.5 The take-up reel is equipped with two foil reflecting strips spaced 180 degrees apart, figure 2-5, so that they produce two reflections per complete rotation. These reflections are sensed by the sensor amplifier to produce the —LOW TAPE SIG pulses which are applied to the input of the load counter (0390). The load counter consists of six counter stages, and provides the necessary timing to control the load cycle. To insure that the load counter is set to zero at the start of a load cycle, the low -THREAD TU MTR DR output of gate 705-8 (0401) is differentiated by C620 and R625 (0390) to form a low pulse. This pulse is routed via gate 622-8 and inverter 634-6 to the clear direct inputs of all six counter stages, thereby setting the counter to zero.

2.11.6 With the take-up reel rotating at thread speed, the counter begins counting —LOW TAPE SIG pulses. After four revolutions of the take-up reel, the counter has counted eight pulses. LOAD CNTR 8 is high and —LOAD CNTR 8 is low at this time. The low —LOAD CNTR 8 level is applied to one input of gate 418-8 (0400), causing the output of that gate to go high. The high output is applied to the input of gate 705-6 (0401). The remaining inputs to gate 705-6 are THREAD (high), —BACKUP (high), and —CART MTR OPEN DR (used with cartridge option and described in paragraph 2-17). Therefore, the gate is enabled, producing a low —THREAD SUP MTR DR signal which is fed to the reel drive circuits causing the supply motor to start threading.

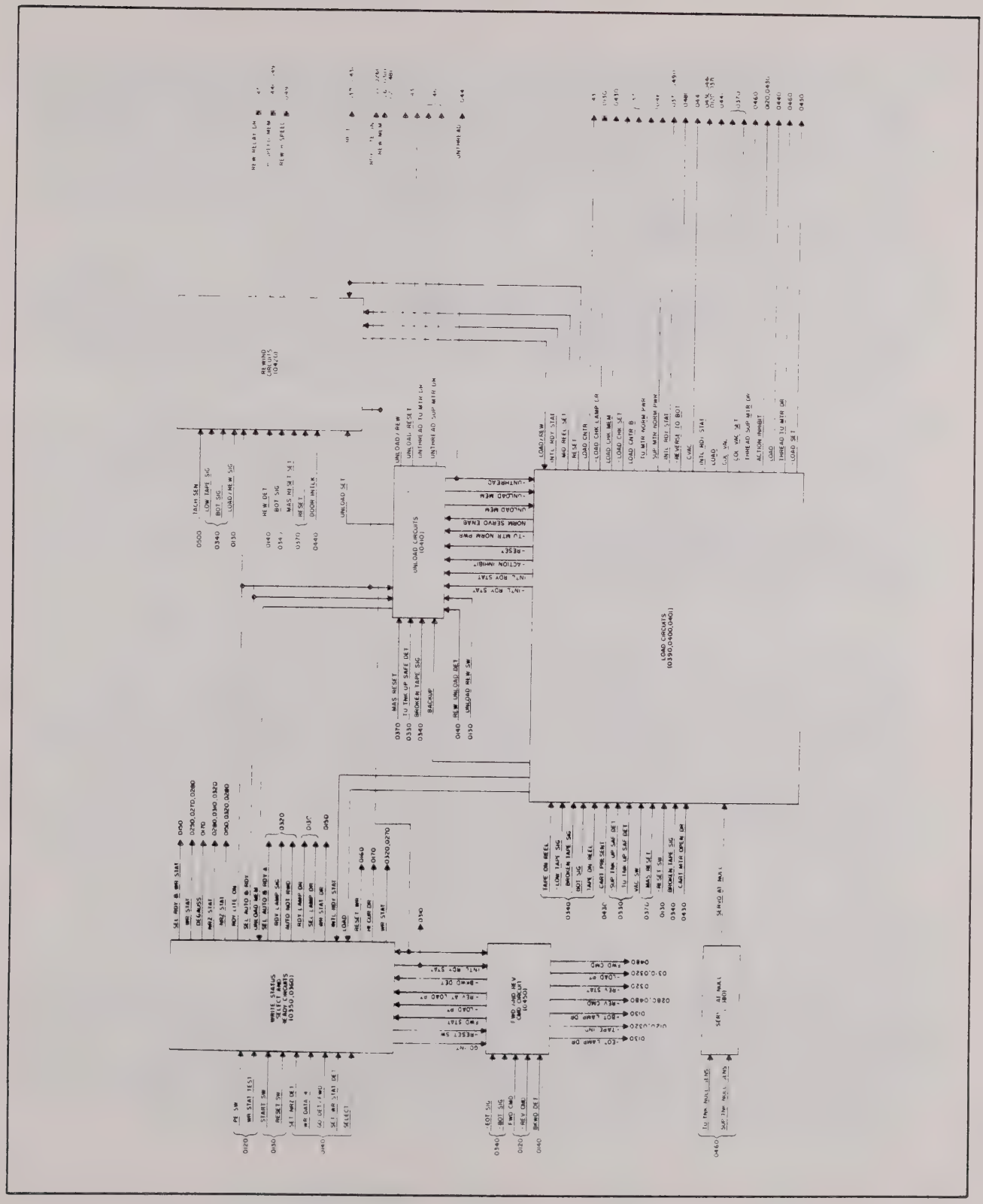

Figure 2-4. Motion Control Circuits, Block Diagram

2.11.7 As the supply motor starts threading, tape is drawn through the threading channel by the air pressure jets. At 16 counts, the fifth counter stage produces a high LOAD CNTR 16 and a low –LOAD CNTR 16 level. The load circuits perform the first of their load checks at this time. The high LOAD CNTR 16 level is applied to one input of gate 422-12 (0390). If there is no cartridge, -CART PRESENT is high. The third input to the gate, BROKEN TAPE SIGNAL, is high when there is no tape across the EOT/BOT sensor. Therefore, if the tape has not threaded its way at least to the EOT/BOT sensor by the time the load counter reaches 16, gate 422-12 is enabled, producing a low output which sets the load check flip-flop 427-6, 422-8.

2.11.8 The high LOAD CHK MEM level is applied to gate 319-11 in the master reset circuit (0370). If no cartridge is present, –CART PRESENT is high and gate 319-11 is enabled. The low output of this gate sets the master reset flip-flop 323-6, 319-8 (0371). The high output of 323-6 is inverted by 328-8 to form the low –MAS reset level which is applied to the reset side of the load flip-flop, resetting it, and ending the load cycle.

2.11.9 If the tape does reach the EOT/BOT assembly by count 16, the load check circuits then look for the –TAPE ON REEL signal to be low at count 24, signifying that the tape has reached the take-up reel. Gate 422-6 (0390) performs this check. The inputs to this gate are the –TAPE ON REEL signal which is high when the tape has not reached the take-up reel, and the LOAD CNTR 8 and LOAD CNTR 16 levels, which are both high at count 24. Therefore, if the tape has not reached the take-up reel by count 24, gate 422-6 is enabled producing a low output which sets the load check flip-flop. This resets the load flip-flop as described earlier.

2.11.10 If the tape does reach the take-up reel by count 24, the load check circuits then look for the threading cycle to be completed by count 56. If the BOT SIG from the sensor amplifier goes high between counts 16 and 56, indicating that the BOT foil has been sensed, gate 622-6 (0400) is enabled. The input to this gate are BOT SIG (high when BOT is detected), TAPE ON REEL (high when tape reaches take-up reel), THREAD (high during load cycle), and either LOAD CNTR 16 or LOAD CNTR 32 (via gate 627-6). The low output of enabled gate 622-6 sets the column vacuum flip-flop 618-6, 618-8. With the column vacuum flip-flop set, a low –COL VAC (–CVAC) level is applied to gate 723-6 (0440) and gate 728-3 in the motor control. This low level inhibits gate 723-6, removing the low –TRANSFER VALVE DR signal and thereby deactivating the transfer valve. This switches the vacuum from the threading channel to the tape columns. The low –COL VAC (–CVAC) level is also applied to gate 728-3 holding the –VAC MTR DR signal on even when the –LOAD level goes high after the load cycle is completed. When the COL VAC flip-flop is set, the load counter is reset and the MTS will check that the vacuum switch is closed before LOAD CNTR 8 is a ONE. If this does not occur, the cycle is aborted.

2.11.11 The high COL VAC (CVAC) level is applied to gate 613-11 (0400), which is enabled when the vacuum is on (VAC SW is high). The low output of enabled gate 613-11 generates a high NORM SERVO ENABLE signal via gate 613-3. This high signal is applied to gate 608-8 (0410) in the unload circuits. The second input to that gate is the –TU MTR NORM PWR level, which is high at this time. Enabled gate 608-8 produces a low –UNTHREAD TU MTR DR level which is applied to the reel drive circuits, causing the take-up motor to reverse direction and let tape drop into the tape columns.

2.11.12 As soon as the tape is fed into the tape columns, the upper column safety sensors detect the tape. This causes the –SUP TNK UP SAF DET and –TU TNK UP SAF DET levels to go high. With these signals high, gates 605-8 and 608-6 (0401) are enabled. The enabled gates produce the low –SUP MTR NORM PWR and –TU MTR NORM PWR levels which are applied to the reel drive circuits, enabling normal power on the reel servo system. The low –TU MTR NORM PWR level also inhibits gate 608-6 (0410), removing the low –UNTHREAD TU MTR DR signal.

2.11.13 The reel servo system operates to place tape in the middle of both tape columns. When this condition occurs, within the pre-established tolerances, the SERVO AT NULL level goes high, enabling gate 831-8 (0400), whose other input is the high COL VAC level. Enabled gate 831-8 produces a low output which sets the internal ready flip-flop 831-11, 834-6. The high output of 831-11 (INTL RDY STAT) is applied to gate 831-3, whose second input is the high LOAD level, enabling the gate. The low –REVERSE TO BOT output of the gate is applied to the capstan drive circuits causing the tape to be run at normal reverse speed. This continues until the BOT foil is detected.

2.11.14 When the BOT foil is detected, the high BOT SIG is applied to gate 714-8. The second input to that gate is the high INTL RDY STAT level, enabling the gate. The low output of enabled gate 714-8 resets the LOAD flip-flop, ending the cycle.

2.11.15 Now, if the COL VAC flip-flop is not set by 56 counts, the load flip-flop remains set and the THREAD level remains high. This level is applied to gate 418-6 (0390). Gate 418-6 also receives LOAD CENTR 8, LOAD CNTR 16, and LOAD CNTR 32. Therefore, if the load counter is not reset by count 56 (8+16+32), gate 418-6 is enabled. The low –LOAD CHK SET output of the enabled gate sets the load check flip-flop, aborting the load cycle as described earlier.

2.12 LOAD CYCLE WITH CARTRIDGE (EASY LOAD 1 FEATURE)

2.12.1 The basic difference between the load cycle with a cartridge installed and that described in paragraph 2-11 is that the load circuits will retry to load tape after a load check abort. Also, the load check circuits do not perform a broken tape signal check at count 16 when a cartridge is installed.

2.12.2 Depressing the LOAD/REW switch on the control panel causes the load flip-flop 714-11, 718-6, (0400) to be set, as before. The low –LOAD SET output of enabled gate 714-6 is also applied to the direct clear inputs of the retry counter, which consists of flip-flops 431-5 and 431-9 (0390), setting that counter to zero.

2.12.3 As described previously, the take-up reel is now activated and the 6-stage load counter begins counting –LOW TAPE SIG pulses. At count 8, a –LOAD CNTR 8 level is inverted at gate 418-8 (0400) and a high is applied to gate 705-6 (0401). The remaining inputs to gate 705-6 are –BACKUP (high), THREAD (high), and –CART MTR OPEN DR. The –CART MTR OPEN DR signal is high if no cartridge is present (as before), or if the cartridge motor is open. Therefore, if the cartridge motor is open, the –THREAD SUP MTR DR level is generated as before, and tape is fed into the threading channel. However, if the cartridge is closed, gate 705-6 is inhibited and no tape will be fed into the threading channel. This will cause a load cycle abort at the first load check.

2.12.4 The first load check comes at count 24, when gate 422-6 (0390) checks to see whether the tape has reached the take-up reel. If not, gate 422-6 is enabled, setting the load check flip-flop 427-6, 422-8. The leading edge of the resulting low output from 422-8 is counted by the first stage, 431-6, of the retry counter. The low output from set flip-flop 431-6 is inverted by gate 434-6 to form a high which is applied to gate 427-8.

2.12.5 With the load check flip-flop set, a high LOAD CHK MEM level is applied to a second input of gate 427-8. The third input to that gate is the high LOAD CNTR 16 level. Therefore, gate 427-8 is enabled, producing a low –BACKUP level.

2.12.6 The low –BACKUP level inhibits gate 705-8 (0401), removing the –THREAD TU MTR DR, thereby stopping the threading motion of the take-up reel. The low –BACKUP level is also applied to gates 627-8 and 627-11 in the unload circuits (0410). These gates produce high outputs which are in turn inverted by 631-6 and 631-8, respectively, to form the low –UNTHREAD SUP MTR DR and –UNTHREAD TU MTR DR levels. These levels are fed to the reel drive circuits, causing the reel motors to unthread tape.

2.12.7 As the reel motors unthread tape, the load counter continues to count –LOW TAPE SIG pulses. At the count of 32, the LOAD CNTR 16 level goes low, inhibiting gate 427-8 (0390) and removing the low –BACKUP level. This, in turn, removes the unthread drive levels, and reapplies the thread motor drive levels.

2.12.8 At this point, the tape is completely back into the cartridge and ready for a second threading try. The negative going edge of the –THREAD TU MTR DR is differentiated by C620, R625 (0390) and used to reset the load counter for the second try.

2.12.9 The cycle repeats itself. If at count 24 of the second try the tape has still not reached the take-up reel, the load check flip-flop is set again. The retry counter now is set to 2, with a low output at 431-8 and a high at 431-9. The –BACKUP signal is developed as before, causing the MTD to unthread. However, the low output of 431-8 inhibits gate 431-11 preventing the load check flip-flop from resetting. In addition, after the tape has unthreaded back into the cartridge, at the count of 32, gate 434-8 is enabled. The low output, –LOAD CNTR, is applied to the MAS reset flip-flop, 323-6, 319-8 (0371), setting the flip-flop. The resulting low –MAS RESET signal resets the load flip-flop, ending the cycle.

2.13 UNLOAD CYCLE

2.13.1 The unload cycle is initiated at the control panel by depressing the UNLOAD switch S2 (0130). This generates a low –UNLOAD/REW SW signal which is inverted by 309-10 (0410). The resulting high enables gate 304-11 whose second input is the high –RDY LITE ON level which is low only during remote operation. The low output of enabled gate 304-11 is the –UNLOAD/REW signal. This signal is inverted by 709-2 to form the high UNLOAD/REW signal which is fed to gate 734-6. The other inputs to that gate are –ACTION INHIBIT (high) and INTL RDY STAT (high). Therefore gate 734-6 is enabled, producing a low output which sets the unload flip-flop 728-8, 731-6. The low output, –UNLOAD SET, is also inverted by gate 728-11 (0420). The high output of that gate enables gate 734-12 whose other inputs, INTL RDY STAT and –BOT SIG are both high. The low output of enabled gate 734-12 sets the rewind flip-flop 1036-3, 1027-8.

2.13.2 When the rewind flip-flop sets, the leading edge of the low output of 1027-8 sets flip-flop 1033-9. This flip-flop produces the low −H SPEED MEM level which is fed to gate 334-11 (0440) in the motor control, inhibiting that gate and deactivating the tape cleaner solenoid drive. In this manner, when the MTS is rewinding at high speed, the tape is removed from the tape cleaner preventing unnecessary wear.

2.13.3 The high output from 1033-9 (0420) enables gates 1036-6 and 1023-6, producing a low −REW H SPEED level and a −H SPEED REEL SIG level, respectively.

2.13.4 The low −REW MEM level is fed to the capstan drive circuits along with the low −H SPEED MEM causing the capstan to rewind at high speed. The low −H SPEED REEL SIG is inverted by 1128-2 and applied to driver Q1123 to operate the rewind power switches in the reel drive circuits. These switches apply the high-speed rewind voltages to the two reel motors (model 4025 only).

2.13.5 When the tape has been rewound at high speed to the point where the low tape sensor is activated, the low −LO TAPE SIG sets the lo tape flip-flop 1027-6, 1023-11 (0420). When this flip-flop is set, its low output inhibits gate 1036-6, removing the low −REW H SPEED signal. This in turn switches the capstan to normal speed reverse. The change in speed is sensed at amplifier 1013-8 and a low speed, LSPD, signal is generated. This signal enables gate 1023-3, producing a low output which resets the rewind high speed flip-flop 1033-9. In addition, inverter 1018-6 produces a low signal which inhibits gate 1023-6, thereby causing the reel motors to switch to normal servo control.

2.13.6 When the tape is rewound to the BOT marker, a low −BOT SIG resets the rewind flip-flop. In addition, a high BOT SIG enables gate 834-8 (0400) whose other two inputs, UNLOAD MEM and SERVO AT NULL are both high at this time. The low output of enabled gate 834-8 resets the internal ready flip-flop 831-11, 834-6.

2.13.7 When the internal ready flip-flop is reset, a high −INTL RDY STAT level is applied to gate 728-6 (0410). Since the unload flip-flop is set at this time, gate 728-6 is enabled, producing a low −UNTHREAD level. The leading edge of −UNTHREAD resets the column vacuum flip-flop 618-6, 618-8 (0400), removing power from the vacuum motor (0440). Reel motor power is maintained however by the low −UNTHREAD level inverted by gate 613-8 (0440) to apply a low −MTR PWR DR level to the reel drive circuits.

2.13.8 The low −UNTHREAD level is also inverted by gate 627-8 (0410) and again by inverter 631-6 to form a low −UNTHREAD SUP MTR DR level which is fed to the reel drive circuits, causing the supply reel to wind in tape. Since the take-up reel is not unthreading at this time, the supply reel begins to remove tape from the take-up tank. When the tape is removed past the upper safety sensor, the TU TNK UP SAF DET signal goes high. This enables gate 627-3 (0410) which also receives the high UNTHREAD level from inverter 634-2. The low output of enabled gate 627-3 is inverted by gate 627-11 and again by inverter 631-8 to form the low −UNTHREAD TU MTR DR level. This level is applied to the reel drive circuits causing the take-up reel to unthread.

2.13.9 As long as tape is at or past the EOT/BOT sensor assembly, while in an unload cycle, the −BROKEN TAPE SIG is high and the output of gate 1036-8 (0390) is high. Gate 1036-11 remains enabled producing a low output which is inverted by gate 622-8 and then by inverter 634-6 to produce a low which clamps the load counter to zero. When the tape is unthreaded past the EOT/BOT sensor assembly, −BROKEN TAPE SIG goes low, removing the clamp. The load counter begins to count low tape pulses. When the load counter reaches 2, gate 734-8 (0410) is enabled, resetting the unload flip-flop, and removing the unthread motor drive signals.

2.13.10 In addition, if a cartridge is present, the low output of gate 734-8 (0410) sets the cartridge motor close flip-flop 309-8, 309-6 (0430). The high output of 309-8 enables gate 306-8 producing a low –CART MTR CLO DR signal. This signal causes the cartridge to close. When the cartridge is closed, a low –CART CLO DET level from switch S10 inhibits gate 306-8 stopping the cartridge motor. This ends the unload cycle.

2.13.11 The unload cycle may also be initiated by the computer. The CUST UNLOAD CMD from the computer is fed to the line receivers (0140 and 0141) which produces the REW/UNLOAD DET signal. This signal is applied to gate 318-3 (0410). If the MTD is under computer control, the SEL AUTO & RDY level is also high, enabling gate 318-3 and producing the low –UNLOAD/REW signal which starts the unload cycle.

2.14 REMOTE OPERATION

2.14.1 When tape is loaded and it is desired to place the MTD under computer control, the START switch, S4, (0130) is depressed. This produces a low –START SW signal which is inverted by inverter 609-2 (0350) to form a high output. This high is applied to gate 709-12. The remaining inputs to gate 709-12 are –UNLOAD MEM (high) and –RESET SW (high). Therefore, gate 709-12 is enabled, producing a low output which sets the ready flip-flop 714-6, 709-8. This produces a high RDY LITE ON level which is applied to gate 709-6. Gate 709-6 also receives the high INTL RDY STAT level via inverter 509-4 and the high –LOAD level. The enabled gate produces a low output, –RDY LITE ON, which is inverted by inverter 718-6 and applied to gates 714-11 and 714-3. Gate 714-11 also receives the high –REW MEM level and produces a low RDY LAMP SIG which is inverted by inverter 1005-4 and driven by lamp driver Q1105 to produce the –RDY LAMP DR level which lights the READY lamp on the control panel.

2.14.2 The low –RDY LAMP SIG is inverted by inverter 718-4 to form the high AUTO NOT REW level which is inverted by the line drivers (0320) and routed to the computer as the low CUST REW RPY. This indicates to the computer that the MTD is under computer control and not rewinding. The low –RDY LAMP SIG is also applied via the line drivers to the computer as the high CUST RDY signal indicating to the computer that the MTD is ready for computer control.

2.14.3 Gate 714-3 also receives the high SELECT level from the line receivers (0140 and 0141), indicating that this particular MTD has been selected by the computer to receive data and commands. The low output of enabled gate 714-3 is inverted by inverter 723-6 to form the high SEL AUTO & RDY A level, and by inverter 723-8 to form the high SEL AUTO & RDY level. The high SEL AUTO & RDY A level is applied via inverters 536-2 (0320) and 536-6 as a low enabling level to the line drivers, allowing read data and replies to be fed to the computer via the line drivers.

2.14.4 The high SELECT level is also inverted by inverter 718-2 (0350) and again by 1005-2 and applied to lamp driver Q1105-7. The lamp driver output, –SEL LAMP DR, lights the SELECT lamp on the control panel.

2.14.5 With the MTD now selected and ready, the computer may begin a write operation by sending a CUST SET WR STAT command to the line receivers. The line receivers (0140 and 0141) then produce a high SET WR STAT DET signal which is applied to inverters 609-6 and 609-10. The low output of 609-10 inhibits gate 614-6. The low output of 609-6 is inverted by inverter 609-8 and applied as a high input to gate 618-6. Gate 618-6 also receives the –FP SIG which is high if the reel is not file protected, SEL AUTO & RDY (high), and –REW MEM (high). Therefore the gate is enabled, producing a low output which sets the write status flip-flop 622-6, 618-8. The resulting low output of 618-8 is inverted by gate 622-3 to form the high WR STAT level. Inverter 626-2 produces the low –WR STAT level.

2.14.6 The high WR STAT level is applied to the line drivers inhibiting the CUST RD STAT line, thereby informing the computer that the MTD is in write status. The WR STAT and –WR STAT levels are also fed to the read circuits and to the write circuits indicating whether a read or write operation is to take place.

2.14.7 If NRZ mode is selected by the computer, the CUST SET NRZ command is applied to the line receivers (0140 and 0141) which produce a high SET NRZ DET signal. This high is applied to gate 416-3 (0360), enabling that gate when the MTD is selected and ready (SEL AUTO & RDY is high). The low output of gate 416-3 sets the NRZ status flip-flop 404-8, 404-6. This produces the high NRZ STAT level which is applied to the write circuit controls, and the read circuits. The low –NRZ STAT level from inverter 409-8 is also applied to the write circuit controls, the read circuits, and the line drivers (0320). The line drivers, in turn, produce the CUST NRZ STAT RPY to the computer. A low –NRZ STAT level is applied to one input of gate 318-11 (0360), inhibiting that gate when the MTD is in an NRZ mode. This produces a high HI CUR DR level during NRZ mode, which is applied to the write circuits.

2.14.8 The NRZI status flip-flop is reset, by the low –LOAD PT signal, whenever a tape is loaded. Therefore, if a SET NRZ DET signal is not developed, the NRZ status flip-flop remains in the reset state, indicating PE mode. If the MTD is to be used for PE mode recording only, the output of the NRZ status flip-flop is tied to ground permanently.

2.14.9 Gate 318-11 produces a high HI CUR DR signal when either of its inputs are low. The first case is during NRZ mode. The second case is when flip-flop 318-8, 322-8 is set. The setting of the flip-flop is controlled by gate 322-6. If the MTD is in rewind (–REW MEM is low), or if the MTD is not selected and ready (SEL AUTO & RDY is low), or if the MTD is in reverse and at the BOT marker (–REV AT LOAD PT is low), or if neither a backward nor a forward command is detected (–BKWD DET is high or GO DET FWD is low), then gate 322-6 produces a high output which is inverted by inverter 326-6 to form a low GO INT signal which sets the flip-flop.

2.14.10 Gate 318-11 produces a low HI CUR DR when in PE mode (–NRZ STAT is high) if flip-flop 318-8, 322-8 is reset. This occurs when in a read operation (WR STAT is low), when in write test (–WR STAT TEST is low), or when the fourth write data bit is a ONE (WR DATA 4 is high) signifying that data have been received by the computer indicating the end of the interblock gap. Bit 4 is used because it is always used in writing a tape mark but is not used in writing the PE identification burst. Therefore, TM's, ID Bursts and gaps are written in Hi-Current mode – not Step Write.

2.14.11 At the end of a write operation, –WR STAT goes to a high level. This activates the oscillator composed of pulse shaper 421, 326-10 and gate 426-8. The output of enabled gate 426-8 is the DEGAUSS square wave which alternates the current in the write heads.

2.14.12 If a CUST RUN/FWD command from the computer is received by the line receivers (0140 and 0141), the resulting high GO DET/FWD signal enables gate 322-6 (0360) whose other inputs are high if not in reverse or rewind. This produces a high GO INT output from inverter 326-6. This high is applied to gates 522-6 (0450) and 522-11.

2.14.13 If no CUST REV CMD is present, indicating that the MTD should run forward, BKWD from the line receivers (0140 and 0141) is low. This low is inverted twice by inverters 509-12 and 509-10, to form a low which resets the reverse status flip-flop 518-6, 522-3 (0450). The resulting low REV STAT output from 518-6 is inverted by inverter 624-4 to form an enabling high for gate 522-6. The low output of 522-6 is the –FWD CMD which is applied to the capstan drive circuit causing the MTD to run forward.

2.14.14 If the CUST REV CMD is present, indicating that the MTD should run in reverse, BKWD from the line receivers (0140 and 0141) is high. This high is inverted by 509-2 to form a low which sets the reverse status flip-flop 518-6, 522-3. The high output of 518-6 enables gate 522-11 to form a low –REV CMD which is fed to the capstan drive circuit causing the MTD to run in reverse. The reverse status flip-flop is also set by the low –REW MEM signal during rewind.

2.14.15 The load point flip-flop 531-3, 526-6 (0450) monitors the BOT sensor and sets when a low –BOT SIG from the sensor amplifier is detected. This low is inverted by inverter 626-6 and the resulting high enables gate 526-12 when the internal ready status flip-flop is set. The low output of enabled gate 526-12 sets the load point flip-flop. This produces a low –LOAD PT signal from the inverter 626-8, fed to the read circuits, and also via the line drivers (0320) to the computer as the CUST BOT RPY signal. Inverter 1005-12 feeds a high to lamp driver Q1105-9, which in turn lights the BOT indicator on the front panel. If a reverse command is received when at the BOT marker, gate 522-8 is enabled producing a low –REV AT LOAD PT level, which inhibits the motion commands at gates 522-5 and 522-11.

2.14.16 When a FWD CMD causes the tape to move off the BOT marker, the –BOT SIG goes high, enabling gate 622-8. The low output of 622-8 resets the load point flip-flop. This flip-flop is also reset when the internal ready status is reset.

2.14.17 The end of tape indication flip-flop 531-6, 518-8 monitors the EOT sensor, and sets when a low –EOT SIG from the sensor amplifier is detected. This low is inverted by inverter 626-10 and the resulting high enables gate 531-11. The low output of enabled gate 531-11 sets the flip-flop. With the flip-flop set, inverter 409-4 produces a low –TAPE IND level to the line drivers which produce a CUST EOT RPY signal to the computer. In addition, inverter 1005-10 feeds lamp driver Q1105-12 which causes the EOT indicator on the control panel to light.

2.14.18 The end-of-tape indication flip-flop is reset when a reverse command or a rewind operation causes the tape to move off the EOT marker. This causes gate 531-8 to be enabled, producing a low output which resets the flip-flop. The flip-flop is also reset when the internal ready status is reset, or when the RESET switch is depressed.

2.15 WRITE CONTROL CIRCUITS

2.15.1 The write control circuits provide the various enabling signals required during a write operation. When the write status is determined, as described earlier in paragraph 4.14, a high SEL RDY & WR STAT level is applied to gate 108-3 (0150). This enables the gate allowing the write clock pulses, WR CLK, which are also applied from the computer (CUST WR CLK) via the line receivers (0140 and 0141) to gate 108-3. The write clock pulses are routed via gate 118-3 to the write circuits.

2.15.2 If the MTD is in PE recording status, the –NRZ STAT level is high. This high is inverted by inverters 114-4, and 114-8 to apply an enabling high to gate 118-11. The enabled gate 118-11 passes the write clock pulses as the –PE WR CLK pulses to the write circuits.

2.15.3 When in NRZ recording mode, the –NRZ STAT level is low. This low is inverted by gate 108-6 and applied to inverters 114-6, 918-6, and 918-3. These inverters produce the low –NRZ LOCAL 1, 2, and 3 levels to the write circuits.

2.15.4 The low NRZ STAT level is also inverted by inverters 114-4 and 118-6 and applied to amplifier Q125 to develop the NRZ CUR current required in NRZ mode by the write circuits.

2.15.5 When a longitudinal check character is to be written at the end of a record, a CUST WR LRC CHAR command from the computer is applied to the line receivers (0140 and 0141). The resulting high WR CHK CHAR signal is applied to gate 108-11 (0150). Gate 108-11 is enabled (SEL RDY & WR STAT is high) and a high WR LONG CHK CHAR signal is sent via inverter 114-2 to the write circuits.

2.15.6 When the write status is set, amplifier Q135 produces a WR STAT DR signal to the write circuits.

2.16 LINE DRIVERS

2.16.1 The line drivers (0320) receive various status and reply signals in MTD logic convention and convert these signals to computer logic convention. These conventions are described in Table 2-1. The line drivers are only operative when the high SEL AUTO & RDY A level is present.

2.17 MASTER RESET CIRCUIT

2.17.1 The master reset circuits monitor various MTD status and sensor signals and under error conditions generate an ERROR CONDITION signal which sets the master reset (MAS) flip-flop (0371).

2.17.2 The first error condition checked by the master reset circuit is for a burned-out sensor lamp. If power is on, the PWR PRESENT 1 and PWR PRESENT 2 signals from the power supply are both present. This produces a high –PWR OFF level at the output of amplifier 1003-8. The high is applied to one input of gate 613-6. The second input to that gate is the output from a diode OR gate. This gate receives the lamp detect signals from the TTP, TNK 1, TNK 2, EOT/BOT, and LTP lamps. If any of these lamps have a burned out filament, a low will be produced at the output of the diode OR gate. This low is inverted by gate 613-6 and inverter 1315-10 to form a low –LAMP OUT SIG. The low –LAMP OUT SIG is then routed via gate 330-4, as the low –ERROR CONDITION signal, to set the master reset flip-flop.

2.17.3 A second error condition monitored by the master reset circuit is when the tape has bottomed in the tape columns during normal operation. If tape has bottomed in either the supply tank or the take-up tank tape column, the corresponding low safety detector produces a low output. If either SUP TNK LO SAF DET or TU TNK LO SAF DET goes low, gate 330-4 is activated, producing a low –ERROR CONDITION level, setting the master reset flip-flop

2.17.4 The master reset circuit also checks that the vacuum is in the tape columns when the tape is loaded. This check is performed by gate 334-6 which is enabled when –VAC SW is high, indicating that no vacuum is in the tape columns, and when INTL RDY STAT is high, indicating that tape is loaded. The resulting low output of gate 334-6 is routed via gate 330-4 as the low –ERROR CONDITION signal to set the master reset flip-flop.

2.17.5 As power is turned on, the +5-volt power supply causes differentiator R332, C328 to produce a low pulse which is applied via gate 330-11 to the master reset flip-flop as the low –ERROR CONDITION signal.

2.17.6 Gate 309-6 checks that the vacuum has been switched into the tape columns, during the threading operation of the load cycle. When BOT is sensed, threading continues until a count of eight on the load counter (LOAD CNTR 8 is high). At this time, if the vacuum switch still has not switched, the remaining inputs to the gate are high and the gate is enabled. The resulting low output is applied via gate 330-11 as the –ERROR CONDITION signal to set the master reset flip-flop.

2.17.7 Gate 834-12 produces a low output, which in turn produces a low –ERROR CONDITION signal, when the reset switch is depressed as the MTD is attempting to complete the load cycle. This is provided to allow the operator to abort the load cycle at any time.

2.17.8 Finally, when the load check flip-flop is set, indicating that the load operation has failed a particular load test, a low –LONG LEADER CHECK is applied via gate 330-11 to the master reset flip-flop as the –ERROR CONDITION signal.

2.17.9 The master reset flip-flop 323-6, 319-8 (0371) is set under several conditions. First, when the low –ERROR CONDITION signal is produced, the master reset flip-flop is set producing a high MAS RESET which is applied to gates 319-3 and 319-6 (0430), and a low –MAS RESET via inverter 323-8 (0371) which is applied to the load, unload, rewind, and cartridge motor control circuits.

2.17.10 The master reset flip-flop is also set when the load counter reaches count 32 on the second try at loading (–LOAD CNTR is low). This signifies that the second try at loading has also failed and the cycle must be aborted. Gate 334-3 produces a low output, setting the master reset flip-flop, when there is no tape in the tank columns (–TAPE IN COL is high) after the load cycle has been completed (INTL RDY STAT is high).

2.17.11 Finally, the master reset flip-flop is also set when gate 319-11 is enabled. This occurs when an error in the load cycle occurs (LOAD CHK MEM is high) and the supply reel is not equipped with a cartridge (–CART PRESENT is high).

2.17.12 The master reset flip-flop is reset only when the RESET switch on the control panel is depressed.

2.18 CARTRIDGE MOTOR CONTROL

2.18.1 The cartridge motor control (0430) contains the circuits that open and control the cartridge motor. The status of the cartridge is determined by the cartridge present switch S7, the cartridge open switch S9, and the cartridge closed switch S10. If the supply reel is equipped with a cartridge, switch S7 closes, producing a low –CART PRESENT level which is sent to the load circuits, and is applied to inverter 214-2 (0430) and gate 319-11 (0371)

2.18.2 When a load cycle is initiated, it is necessary to open the cartridge so that the tape may be threaded from the supply reel to the take-up reel. The low –LOAD SET signal from the load circuits sets the cartridge flip-flop 309-8, 309-6 into its cartridge open position. This causes a high output from 309-6 which is applied to gate 306-6. If the cartridge is closed at this time, –CART OPEN DET is high, and if a cartridge is present the input to the gate from inverter 214-2 (CART PRESENT) is high. Also, if the master reset is not set at this time, –MAS RESET is high. Therefore, gate 306-6 is enabled producing a

low –CART MTR OPEN DR which is fed to the load circuits and also to the motor control causing the cartridge motor to open. When the cartridge reaches its open position, the cartridge open switch closes, producing a low –CART OPEN DET signal. This low now inhibits gate 306-6, removing the low –CART MTR OPEN DR signal.

2.18.3 During an unload cycle, after the tape has been rewound into the cartridge, the cartridge should be closed. However, should it be required, the cartridge can be manually closed. Gate 315-8 receives a high UNLOAD/REW level when the UNLOAD switch is pressed. If the tape has been completely rewound onto the supply reel, the BROKEN TAPE SIGNAL is high. As long as no action inhibit is present, –ACTION INHIBIT is high. Therefore, gate 315-8 is enabled, producing a low which resets the cartridge flip-flop in its cartridge close condition. The flip-flop is normally reset after an unload by the low –UNLOAD RESET signal. The output of 309-8 is high, enabling gate 306-8 provided that the cartridge is open at this time (–CART CLO DET is high). The low output of enabled gate 306-8 is the low –CART MTR CLO DR level, which is applied to the motor control, causing the cartridge motor to close the cartridge. When the cartridge is closed, switch S10 is closed, producing a low –CART CLO DET level which inhibits gate 306-8, removing the low –CART MTR CLO DR signal.

2.18.4 When the master reset flip-flop is set, a high MAS RESET output from 323-6 is applied to gates 319-3 and 319-6. If the tape has not been rewound into the supply reel, –BROKEN TAPE SIG is high and gate 319-6 is enabled. The low output of this gate sets the cartridge flip-flop into its cartridge open condition. This causes the output from 309-8 to go low, inhibiting gate 306-8 and preventing the cartridge from closing on the tape. The low –MAS RESET from inverter 323-8 inhibits gate 306-6 preventing a low –CART MTR OPEN DR signal from being generated. This circuitry is provided to properly set or reset the flip-flop when power is first turned on.

2.18.5 If the tape has been rewound into the supply reel, the BROKEN TAPE SIGNAL is high. This high enables gate 319-3, producing a low which sets the cartridge flip-flop in its cartridge close condition. The high output of 309-8 then enables gate 306-8 causing the cartridge to close, as described earlier.

2.19 TAPE SENSORS AND AMPLIFIERS

2.19.1 OPTICAL SENSING SYSTEM. The optical sensing system employed by the MTD is illustrated in the simplified drawing of Figure 2-5.

2.19.2 Tape is routed from the supply reel into the supply tank. The supply tank has a tape sensor (SUP TNK UP SAF SENS) at the entrance to the tank which, when activated, indicates that there is no tape in the supply bank. When tape is in the supply tank, the tape covers the sensor preventing light from activating it. In the same manner, there is another sensor at the other end of the tank SUP TNK LO SAF SENS). This sensor is normally exposed to the light source and is only turned off when excessive tape drops into the tank. Therefore, under normal operating conditions, with the tape dropped approximately half-way into the tank, the SUP TNK UP SAF SENS will be off while the SUP TNK LO SAF SENS will be on.

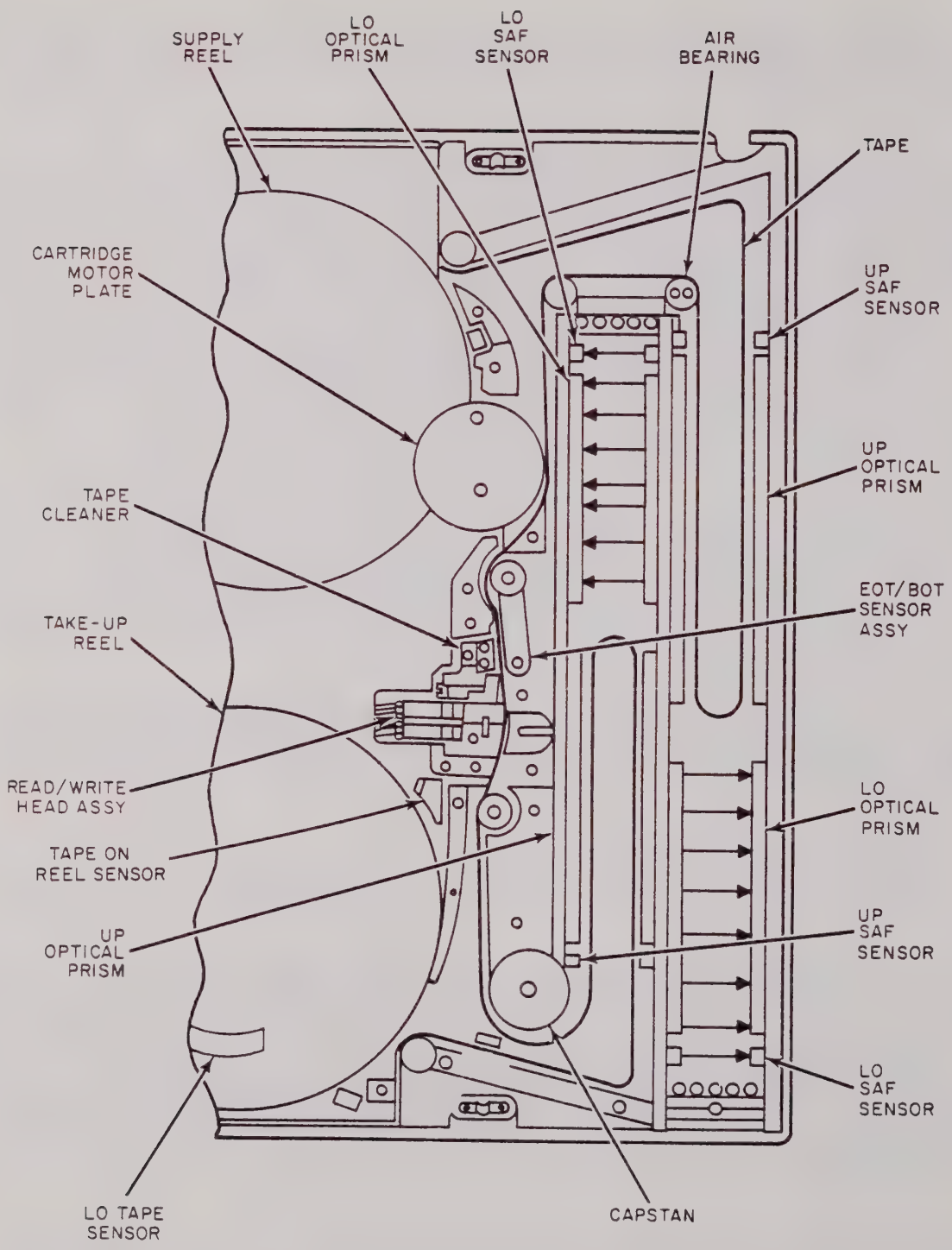

Figure 2-5. MTD Optical System

2.19.3 Along the length of the tank is a linear optical sensor which senses the location of the tape between the two safety sensors. The optical sensor consists of two optical prisms, one which collects light striking it from the entrance half of the tank (SUP TNK UP SENS), and a second which collects light striking it from the other end of the tank (SUP TNK LO SENS). The amount of light collected in each prism varies linearly with the position of the tape from the center of the column. If the tape is exactly at the center of the column, the amount of light collected by the SUP TNK UP SENS sensor is essentially zero while the light collected by the SUP TNK LO SENS is maximum. If the tape is only one-quarter of the way into the column, the amount of light collected by the SUP TNK UP SENS sensor is one-half of the maximum, while the amount of light collected by the SUP TNK LO SENS sensor remains maximum. If the tape is three-quarters of the way into the column, the amount of light collected by the SUP TNK UP SENS sensor is essentially zero and the amount of light collected by the SUP TNK LO SENS sensor is one-half of the maximum.

2.19.4 The voltage output of each sensor is in direct proportion to the amount of light collected by that sensor. If for discussion purposes, the maximum voltage is assigned the value, +V, if the tape is at the center, the output of the SUP TNK UP SENS sensor is 0 and the output of the SUP TNK LO SENS sensor is +V. The reel drive circuits add these two voltages together and add their sum to -V. In this case,

$$0 + V - V = 0.$$

2.19.5 The resulting sum is proportional to the tapes distance from the center, and the polarity indicates the direction from center. In the above case, the 0 sum indicates that the tape is at the center of the column.

2.19.6 If the tape is one-quarter of the way into the column, the calculation performed by the reel drive circuits is as follows:

$$1/2V + V - V = 1/2\ V.$$

2.19.7 The magnitude of 1/2V indicates that the tape is 1/2 of the distance from the center to the end, and the + polarity indicates that the tape is in the direction of the tank opening. If the tape is three-quarters into the tank, the calculation performed is:

$$0 + 1/2V - V = - 1/2\ V.$$

2.19.8 In this case, the - polarity indicates that the tape is toward the closed end of the tank and the magnitude of 1/2 indicates half-way from center to the closed end.

2.19.9 In this manner, the linear optical sending system provides accurate feedback to the reel servo drive concerning the exact position of the tape in the column. The servo then drives to return the tape to the center of the column.

2.19.10 From the supply tank, the tape is routed via air bearing past the EOT/BOT sensor assembly and the read/write head via the capstan to the take-up tank. The EOT/BOT sensor assembly senses the reflective tape strips at the beginning and at the end of the tape. These sensors are activated when the reflective strips are sensed.

2.19.11 The optical system in the take-up tank is identical to that of the supply tank. The sensors include the TU TNK LO SAF SENS and TU TNK UP SAF SENS sensors as well as the two linear optical sensors, TU TNK LO SENS and TU TNK UP SENS.

2.19.12 From the take-up tank, the tape is routed past the tape-on-reel sensor, which detects the tape as it winds onto the take-up reel. This sensor is deactivated when the tape is sensed. The take-up reel itself is equipped with two slots, 180-degrees apart, which allow light to pass through, energizing the LO TAPE SENS sensor every half-revolution whenever the amount of tape on the take-up reel is less than pre-determined.

2.20 TAPE SENSORS

2.20.1 The tape sensors (0330) provide electrical indications of the tape status to the sensor amplifiers and logic of the MTD. The safety sensors, TU TNK LO SAF SENS (Q3), TU TNK UP SAF SENS (Q11), SUP TNK LO SAF SENS (Q9), and SUP TNK UP SAF SENS (Q1) are biased with -0.6 volts via network R803, CR802. Therefore, when they are energized they provide low output signals.

2.20.2 The outputs of these sensors are applied to inverters 1315-4, 1018-10, 1315-2, and 1018-4, respectively. The outputs of these inverters and of inverters 1018-2 and 1018-8 are routed to various control circuits where they are used as described earlier. In addition, gate 1309-6 checks to see that tape is loaded in both columns. If both UP SAF SENS sensors are not activated (–TU TNK UP SAF DET and –SUP TNK UP SAF DET are both high), indicating that tape is in the columns, and both LO SAF SENS sensors are activated (TU TNK LO SAF DET and SUP TNK LO SAF DET are both high), indicating that tape has not dropped to the bottom of each column, gate 1309-6 is enabled producing a low –TAPE IN COL signal, indicating that the tape is properly within the columns. This signal is sent to the master reset circuit as described earlier.

2.20.3 The linear optical sensors (Q4, Q10, Q8, Q2) which collect light from the upper and lower prisms in each column, are energized by +5 volts at their collectors (TU TNK LO SENS COL, TU TNK UP SENS COL, SUP TNK LO SENS COL, SUP TNK UP SENS COL are all +5 volts). The magnitude of the sensor emitter outputs (SENS EM) are each proportional to the amount of light collected by the prism associated with that sensor. These outputs are routed to the reel drive circuits.

2.20.4 The lamps which provide the light source for the tank sensors, DS9 for the take-up tank and DS7 for the supply tank, are energized by +12 volts. The current returns (–TNK LAMP 2 DET and –TNK LAMP 1 DET) for these lamps are routed to the master reset circuits which monitor these returns to check for burned-out filaments. In a like manner, the tape-on-reel (TTP) sensor lamp DS10, the EOT/BOT sensor lamp DS8, and the low tape (LTP) sensor lamp DS11 are all energized by +12 volts and provide current return outputs to the master reset circuits.

2.20.5 The TTP sensor Q7, BOT sensor Q5, EOT sensor Q6, and LTP sensor Q12, are biased at their emitters by a negative voltage from the sensor amplifier. When any of these sensors are activated, they provide a negative collector output to the sensor amplifier.

2.21 SENSOR AMPLIFIER

2.21.1 The collector outputs of the BOT, EOT, LTP, and TTP sensors are applied to the negative inputs of amplifiers 1621-1, 1621-8, 1730-1, and 1730-8 (0340), respectively, of the sensor amplifier. These amplifiers detect and amplify the sensor collector outputs, when the sensors are activated, producing positive outputs which are applied to inverters 1332-10, 1332-12, 1332-4, and 1332-2, respectively. The resulting low –BOT SIG, –EOT SIG, –LOW TAPE SIG (–LTP), and TAPE ON REEL signals are applied to various control circuits as described earlier.

2.21.2 The –BOT SIG is inverted by inverter 1332-8 to form a high BOT SIG which is routed to the control circuits and to one input of gate 1327-8. The –EOT SIG is inverted by inverter 1332-6 to form a high EOT SIG which is applied to the second input of gate 1327-8. If the tape is broken or not loaded, the EOT and BOT sensors both are activated (not by reflected light from the EOT and BOT strips but by reflected light from the mirror above the EOT/BOT assembly. Therefore gate 1327-8 is enabled, producing a low –BROKEN TAPE SIG (–BTS) which is routed to various control circuits as described earlier. The high BROKEN TAPE SIG output of inverter 1128-12 is also routed to the control circuits.

2.22 REEL DRIVE CIRCUITS

2.22.1 The reel drive circuits (0460, 0470) consist of two identical reel servo amplifiers, one controlling the supply reel and one controlling the take-up reel. The servo amplifiers operate in several modes. During a load or unload operation, the amplifiers drive the reel motors based on signals received from the motion control circuits. During normal operation, the amplifiers drive the reel motors based on feedback from the tape sensors. Each of these operations is described in the following paragraphs. Since both reel servo amplifiers are essentially identical, only the supply reel servo amplifier is described completely; any differences are noted for the take-up reel servo amplifier.

2.22.2 THREADING OPERATION. During a load operation, the load circuits generate a –THREAD SUP MTR DR signal which is applied to the control input of FET switch 339-8 (0460). This activates the FET switch, allowing the SUP THREAD V (supply reel threading voltage) from voltage divider R348-R352 to be routed via the switch to amplifier 233-1. The amplifier output is the SUPPLY MOTOR DRIVE CONTROL. This signal, which is at threading voltage level, is amplified by the push-pull amplifier system illustrated in Logic Diagram 0470, to produce a SUP MTR DR voltage. The SUP MTR DR voltage is applied via contacts of energized relay K1 to operate the supply reel servo motor. In this case, the threading voltage operates the motor in a direction such as to let out tape at a speed of approximately 40 rpm.

2.22.3 UNTHREADING OPERATION. During a retry at loading, or at the end of an unload operation, the control circuits generate a –UNTHREAD SUP MTR DR signal. This signal is applied to the control input of FET switch 339-14 (0460). The FET switch activates, allowing the SUP UNTHREAD V (supply reel unthreading voltage) from voltage divider R348-R352 to be routed via the switch to amplifier 233-1. In this case, the resulting SUPPLY MOTOR DRIVE CONTROL causes the supply motor to take up tape at a speed of 100 rpm.

2.22.4 NORMAL SERVO OPERATION. Under normal operating conditions, the servo system operates to keep the tape halfway into the tape columns. As described earlier in the paragraph on the tape sensors, a positive bias is generated by regulator R141, VR142, C143 and applied to the collectors of the SUP TNK UP SENS and SUP TNK LO SENS sensors. The sensors gather light from the optical prisms in the tank and provide a signal from their emitters which varies linearly with the distance the tape is from the center of the columns. These emitter signals are summed in summing network RSU, RSL. The summing network is adjusted so that a center "gain-window" is formed. This window allows the tape to be off the exact center of the tape column by a small fixed amount while still appearing to be on center to the sensing amplifier 154-7. An offset pot is provided so that the tape loop position can be adjusted to the exact center of the column.

2.22.5 The summing network RSU, RSL adds the SUP TNK UP SENS EM and SUP TNK LO SENS EM outputs and adds their total to the offset voltage. The resulting signal is directly proportional to the distance the tape is from the center of the column, and its polarity indicates the direction from the center. If the tape is within the center "window", the output of the amplifier, SUP TNK NULL SENS, is approximately zero volts, indicating that the supply reel servo is at a null. This signal is applied to the servo at null circuit in the control circuits.

2.22.6 If the tape in the supply tank is out of the center "window", the amplifier 154-7 output goes positive or negative depending on the direction from center. The magnitude of the output varies directly with the distance from center. This signal is amplified further by amplifier 233-7 and applied to FET switch 339-6.

2.22.7 Under normal operation, the –SUP MTR NORM PWR signal from the load circuits is low, activating the FET switch and allowing the amplified signal from 233-7 to be applied to the push-pull amplifiers (0470) as the SUPPLY MOTOR DRIVE CONTROL. The reel servo motors drive to move the tape in the supply column to the center "window". As the tape moves toward the center "window", the input to amplifier 154-7 is reduced, thereby reducing the amplitude of the SUPPLY MOTOR DRIVE CONTROL. Once the input to amplifier 154-7 is reduced below the amplifiers input detection threshold, corresponding to the center "window", the servo is at a null and the reel motor stops. In this manner, the supply reel servo system operates to keep the tape position within the column center "window" during normal operation.

2.22.8 REWINDING OPERATION. When the tape is being rewound at high speed during either a load or unload operation, or when responding to a computer rewind command, the –REW HI SPEED SIG from the rewind circuits is low. This low enables switching circuit CR363, R360, removing the CAPSTAN DR V from the capstan drive circuits to be applied via FET switch 339-6 (–SUP MTR NORM PWR is low during rewind) to the push-pull amplifiers as the SUPPLY MOTOR DRIVE CONTROL.

2.22.9 The REW HI SPEED SIG is also applied via amplifier Q212 to amplifiers Q308, Q218 and Q528, Q828. These amplifiers are biased with +60 volts and provide a high + SERVO V voltage to the push-pull amplifiers during rewind. This high + SERVO V bias to the push-pull amplifiers allows the reel servo motor to run at high speed, approximately 2000 rpm.

2.23 CAPSTAN DRIVE CIRCUIT

2.23.1 The capstan drive circuits operate the capstan motor during read and write operations and during a rewind operation. During the read and write operations, the control circuits generate either a FWD CMD or a REV CMD, directing the capstan operation. The following paragraphs describe the operation of the capstan drive circuits in response to a FWD CMD, a REV CMD, and during rewind.

2.23.2 FWD CMD OPERATION. The low –FWD CMD from the control circuits is inverted by inverter 1228-8 (0480) to form a high which is applied to gate 1223-12. Gate 1223-12 receives INTL RDY STAT (high), and SELECT REV (high). The low output of the enabled gate 1223-12 sets the FWD flip-flop 1319-8, 1323-6. This produces a low –SELECT FWD level which is applied to the control input of FET switch 1409-1 (0490–, operating that switch and allowing the forward ramp signal to be amplified by amplifier 1635-12 to form the CAPSTAN DR V.

2.23.3 The ramp signal is developed as follows. When the FWD flip-flop is set, gate 1319-3 (0480) is inhibited by the low –SELECT FWD level. With gate 1319-3 inhibited, the high output of the gate cuts off transistor Q1422, which in turn deactivates FET switch Q1428, placing operational amplifier integrator 1519-1 into the circuit. In addition, the low output of enabled gate 1223-12 is inverted by gate 1319-6 to form a high which is cycled to one input of gate 1327-6. The second input to that gate originates from the low SELECT REV output of flip-flop 1319-11, 1323-8 which is inverted by gate 1327-11 to form a high. Enabled gate 1327-6 produces a low which is inverted by inverters 1228-10 and 1223-8 to form high levels. These high levels cut off transistors Q1419 and Q1235. With both transistors cut off, the acceleration input from potentiometer R ACC is applied to operational amplifier integrator 1519-1.

2.23.4 With the constant acceleration voltage from R ACC applied, the integrator generates a linear ramp output until it reaches approximately +5 VDC. At this time zener diode VR1434 clamps the output of the integrator at this level. The linear charge-up time is the period which the capstan accelerates to its terminal velocity, and the flat clamped period is the constant speed run period.

2.23.5 When the FWD CMD is removed, a high –FWD CMD is inverted by inverter 1228-8 to form a low which inhibits gate 1223-12. The high output of inhibited gate 1223-12 is applied to gate 1319-6. The second input to gate 1319-6 is the high SELECT FWD output from 1319-8. With both inputs now high, gate 1319-6 produces a low output which inhibits gate 1327-6. The high output of inhibited gate 1327-6 is inverted by 1228-10 and 1223-8 to form low levels which saturate transistors Q1419 and Q1235. When Q1235 is saturated, the R ACC circuit is grounded, removing the acceleration input from the integrator. However, with Q1419 saturated, the R DEC circuit is activated, producing a constant deceleration signal which is now applied to the integrator. This signal causes the integrator to discharge to zero, removing the ramp voltage. When the ramp goes to zero, zero detector 1519-7 produces a high output which is inverted by inverter 1228-12. The resulting low resets the FWD flip-flop. With the flip-flop reset, both inputs to gate 1319-3 are high, enabling that gate. The low output of gate 1319-3 saturates transistor Q1422, applying a +5 volt input to the FET switch Q1428 control input. This operates the FET switch, shorting out the integrator and preventing a ramp voltage from being generated.

2.23.6 The ramp voltage produced by the integrator is applied via the R FWD potentiometer (0490), which controls capstan speed, and the activated FET switch 1409-2 to amplifier 1635-12. Amplifier 1635-12 produces the CAPSTAN DR V which is applied to the push-pull capstan motor amplifiers (0500). These amplifiers produce the CAPSTAN MTR DR which drives the capstan motor.

2.23.7 As the capstan motor runs, the capstan generator produces a TACH FDBK signal which is routed via activated FET switch 1409-13 (0490) and combined with the ramp signal at the input to amplifier 1635-12. The TACH FDBK is used as a reference to maintain constant capstan speed.

2.23.8 REV CMD OPERATION. The low –REV CMD is inverted by gate 1223-6 (0480) to form a high which is applied to one input of gate 1323-12. The other inputs to gate 1323-12 are INTL RDY STAT (high) and –SELECT FWD (high). Therefore gate 1323-12 is enabled, producing a low output which sets the REV flip-flop 1319-11, 1323-8. In addition, the low output of 1323-12 is inverted by gate 1327-11 to form a high which is applied to gate 1327-6. The second input to gate 1327-6 is the high output of gate 1319-6. Therefore gate 1327-6 is enabled.

2.23.9 The low output of enabled gate 1327-6 is inverted by inverters 1228-10 and 1223-8 to form highs which cut off transistors Q1419 and Q1235. The circuits then generate a ramp and drive the capstan motor in the same manner as for the FWD CMD.

2.23.10 The operation described for the reverse command in the previous paragraph is identical to the operation initiated by the low −REVERSE TO BOT signal generated by the load circuits. When a rewind operation is performed, the low −REW MEM level also causes the same operations to be performed as for the −REV CMD. However, in the case of a rewind operation, a low −REW HI SPEED level is applied to inverter 1228-4 (0490), and a low −H SPEED MEM level is applied to inverter 1315-8 and transistor Q1528. The low −H SPEED MEM level is inverted twice by inverters 1315-8 and 1315-6 to form a low which activates FET switch 1409-8.

2.23.11 In addition, the low −REW HI SPEED level is inverted by inverter 1228-4 to form a high which enables gate 1327-3 whose other input is INTL RDY STAT (high). The low output of enabled gate 1327-3 saturates Q1508, providing an energizing voltage to operational amplifier integrator 1613-1. Since no attenuating potentiometer is present at the input to this integrator, the resulting rewind ramp output (RWRP) is maximized. This ramp is applied via energized FET switch 1409-9 to amplifier 1635-12. The resulting CAPSTAN DR V drives the capstan motor in reverse at high speed.

2.23.12 At the end of the high speed, rewind, the low tape flip-flop in the rewind circuits is set, indicating that most of the tape has been rewound. This causes the −REW H SPEED signal to go high. With −REW H SPEED high, the resulting low output of inverter 1228-4 inhibits gates 1327-3 and 1023-8. FET switch 1409-8 is still held active by the low −H SPEED MEM level via inverters 1315-8 and 1315-6. Transistor Q1508 is cut off, causing the integrator to discharge to ground, slowing down the capstan. When low speed is reached 1013-8 is high, the high speed memory flip-flop in the rewind circuits is reset, causing the −HI SPEED MEM signal to go high. This, in turn, deactivates the FET switch, removing the rewind ramp signal and enables normal reverse motion to BOT.

2.24 WRITE CIRCUITS

2.24.1 The write circuits receive the write data lines from the line receivers, and generate the appropriate signals required to operate the write heads so that the write data are written on tape in the proper recording mode. The phase-encoded (PE) output of the write data receiver is shown in Figure 2-6. When the data bit is a ZERO, the transition in the center of the bit cell is from a ZERO to a ONE; when the data bit is a ONE, the transition in the center of the bit cell is from ONE to ZERO. If the data are either all ONE's or all ZERO's (c and f, Figure 2-6), the data must also transition at the bit cell boundary in order to allow for a correct transition at the center of the bit cell. If the data bits alternate (d and e, Figure 2-6), the transition at the bit cell boundary is not required and does not occur. It may be observed that the frequency of unchanging data, therefore, occurs at twice the frequency of changing data.

2.24.2 The non-return to zero (NRZ) output of the write data receiver is shown in Figure 2-7. In this format, a ONE is written on tape as a transition while a ZERO is noted by no transition.

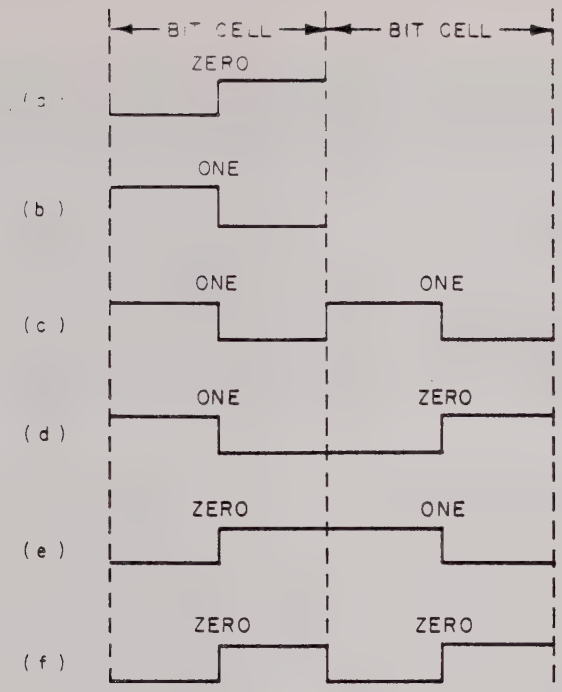

Figure 2-6. PE Mode Recording

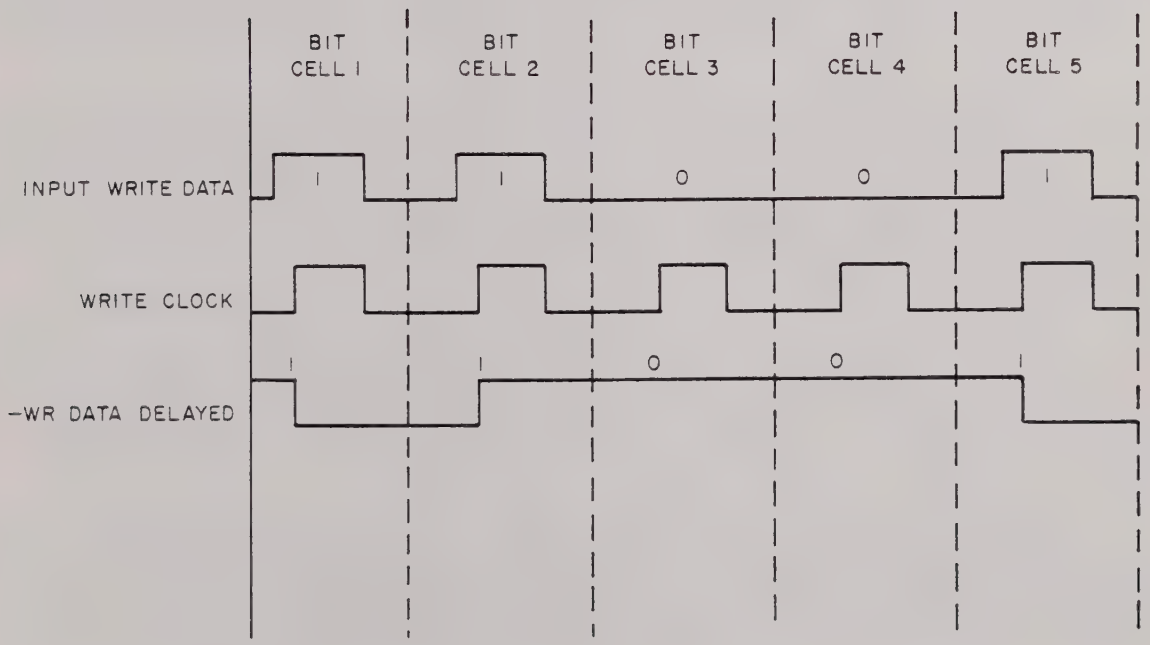

Figure 2-7. NRZ Mode Recording

2.24.3 There are nine identical write circuits, to handle the nine write data lines, in parallel. Since the circuits are identical, only the write data circuit associated with line 1 is described in the following paragraphs. This circuit is illustrated on diagrams 0160 and 0170. In addition, the erase circuit (0250) is described.

2.24.4 WRITE DATA CIRCUIT 1. The write data circuit (0160, 0170) operates in both non-return-to-zero (NRZ) and phase-encoded (PE) recording modes. When in NRZ mode, a transition must occur every time a ONE data bit is applied to the write data circuit. In this mode, –NRZ LOCAL 1 is low, inhibiting gate 214-6 (0160). This causes a high to be applied to the clear input (pin 11) of write data flip-flop 208-9. The low –NRZ LOCAL 1 level is also inverted by gate 214-3 to place a high on the set input (pin 12) of write data flip-flop 208-9. In this manner, the flip-flop is set up as a counter in NRZ mode.

2.24.5 When a ONE is present on the WR DATA 1 line, it is clocked at the input of gate 218-6 by the WR CLK pulse, and applied as a low to single-shot 236-7. The single-shot fires on the leading edge of the input pulse (corresponding to the WR CLK leading edge) producing a low pulse which is inverted by gate 214-8. The trailing edge of the resulting high output pulse from gate 214-8 triggers the write data flip-flop 208-9, causing a transition. Each time a ONE data bit is clocked into the write data circuit, the write data flip-flop changes state. If the data bit is a ZERO, gate 218-6 is inhibited, and single-shot 236-7 does not fire. Therefore, for ZERO data bits, flip-flop 208-9 does not change state.

2.24.6 In PE mode, the –NRZ LOCAL 1 is a ONE; therefore, the WR DATA are inverted by gate 214-6 and applied to the reset input (pin 11) of the write data flip-flop as inverted write data. Gate 214-3 applies true write data to the set input (pin 12) of the write data flip-flop. The –PE WR CLK is inverted and applied to the trigger input of the write data flip-flop. The negative-going trailing edge of the clock pulse triggers the flip-flop causing it to set if the write data bit is ONE, or reset if the write data bit is ZERO. In this manner, each write data bit is registered on the write data flip-flop.

2.24.7 The output of the write data flip-flop, –WR DATA 1 DELAYED is inverted by gate 214-11 (0170) and applied to the high side amplifier for the write head. The data signal is also inverted again by inverter 231-2 and applied to the low side amplifier. Thus, if the –WR DATA 1 DELAYED level is a ONE, the current flows through the write head from the low to the high side. Conversely, if the –WR DATA 1 DELAYED level is a ZERO, the current flows through the write head from the high side to the low side.

2.24.8 In order for the data to be written on tape, however, the supply reel must not be file protected. When the file is not file protected, the WR CUR SW provides +30 VDC and allows write current to flow to the center tape of the write head. If the supply reel is file protected, the 30 VDC is not connected, preventing write current from flowing and thereby preventing data from being written on tape.

2.24.9 When in a write mode, the WR STAT DR signal provides -12 VDC bias voltage for current source composed of Q320, Q330, and Q338. The current source, when triggered, provides the head current while the direction of current flow, and hence the flux is determined by the differential amplifier Q320.

2.24.10 The write amplifier provides current to the write heads at 40 milliamperes in the PE mode, and at 70 milliamperes in the NRZ mode. When a data transition occurs, a pulse is produced by single-shot circuits 218-11 and 236-10. Single-shot 236-10 has an adjustable time constant, set by potentimeter WC1, which determines the width of the constant current pulse to the write head. The pulse output of single-shot 236-10 is inverted by inverter 231-12 and applied to the base of transistor Q338 in the constant current source. This triggers the constant current source, providing the 40 milliampere current to the write head for the particular write cell period.

2.24.11 The HI CUR DR signal is high when writing NRZ data. This high is inverted by inverter 231-10 and applied as a constant low to the constant current source. In NRZ mode, therefore, the constant current source provides a constant 40 milliampere current to the write head.

2.24.12 In addition, when recording in NRZ mode, the NRZ CUR signal energizes transistor Q330 in the constant current source. This transistor, when saturated, provides an additional 30 milliampere current to make up the 70 milliampere constant current for NRZ recording.

2.24.13 At the completion of an NRZ mode record, it is necessary to write an LRC character on tape. the LRC character is generated by checking the number of ONE's recorded in a particular track. If an odd number of ONEs have been recorded, write data flip-flop 208-9 (160) will be set, producing a high output from its pin 9. This high is applied to gate 218-8. The high WR LONG CHK CHAR then enables gate 218-8 producing a low output. The leading edge of this low output triggers single-shot 236-7, applying a low pulse to jack 214-8. This low pulse is inverted by gate 214-8 and the resulting low trailing edge triggers the write data flip-flop 208-9. The flip-flop goes to its reset state, producing a transition which causes the write amplifier to write a ONE LRC bit when the number of ONEs in the track is odd. This provides even longitudinal parity. When the number of ONEs in the track is even, the output of 208-9 is low, inhibiting gate 218-8, preventing a transition, and maintaining even longitudinal parity

2.24.14 ERASE CIRCUITS. The erase head is mounted directly in front of the write heads. Whenever a write operation is being performed, the erase head is activated, erasing the tape just prior to it being written on by the write head.

2.24.15 The erase head (0250) is activated by the low -WR STAT signal which is inverted by inverter 626-12 to form a high. This high is applied to transistor Q633, saturating the transistor and allowing the write current WR CUR SW to flow through the erase head. The WR CUR SW write current is only applied when the supply reel is not file protected. When the reel is file protected, no current is fed to the erase head, and the tape cannot be erased.

2.25 READ CIRCUITS

2.25.1 The read circuits, Figure 2-8, consist of the read head, the read circuits, the read clock, the read circuits interface, and the line drivers. Data are read from tape by the read heads and are amplified within the read circuits. The amplified data are then peak detected within the read circuits.

2.25.2 The peak-detector threshold level is adjusted to a value which depends on whether the MTD is reading or writing, on whether the tape record is in NRZ or PE format, and on whether the computer has sent a CUST SET LO RD THRES signal to the MTD.

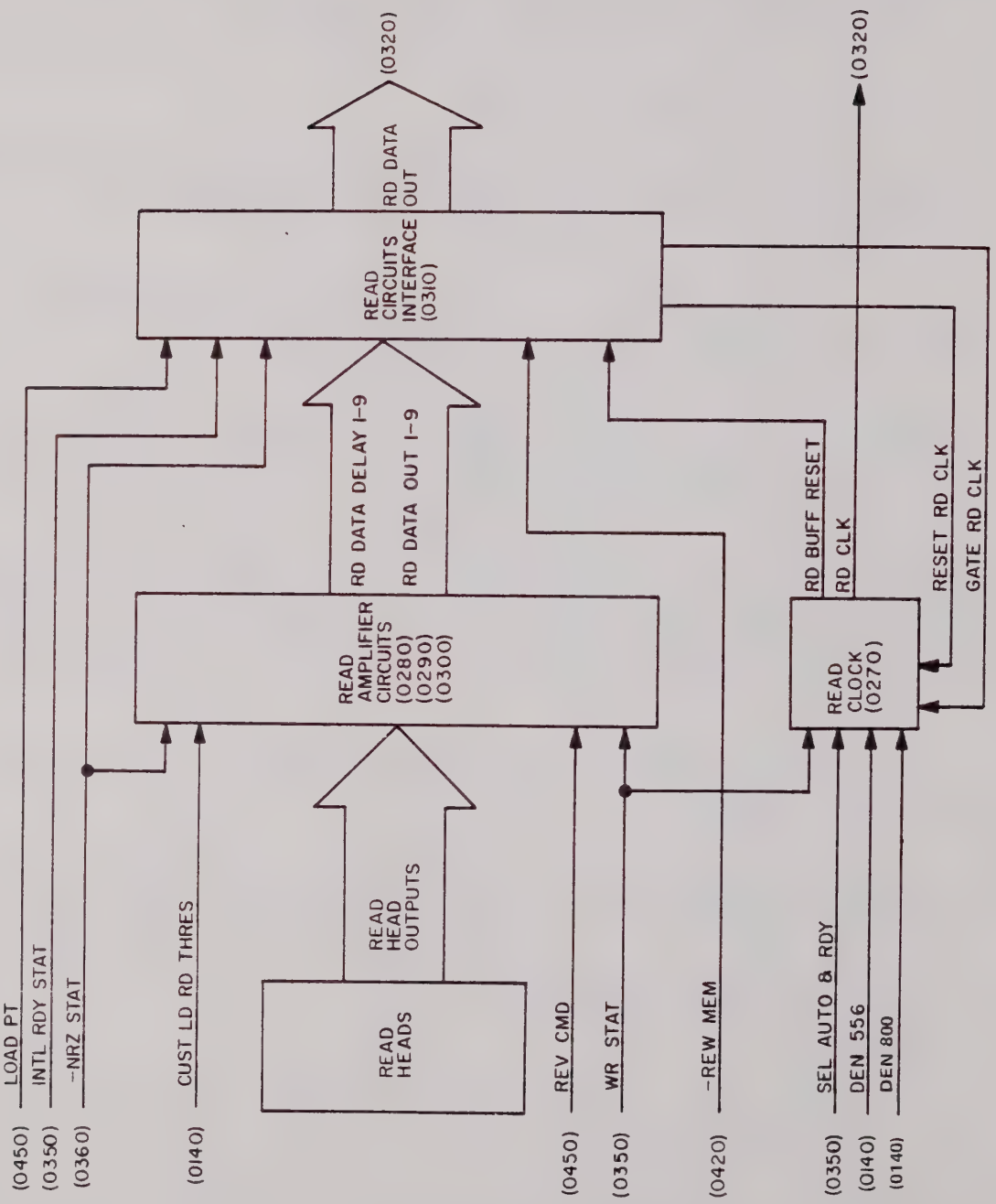

Figure 2-8. Read Circuits, Block Diagram

2.25.3 The read circuits produce a delayed RD DATA DELAY pulse whenever a transition is detected. These NRZ format data bits are fed to the read circuits interface. In addition, the read circuits produce a PE RD DATA OUT signal during a PE mode whenever a ONE bit is detected. This signal is also fed to the read circuits interface.

2.25.4 In the case of PE data, the –READ DATA OUT lines are applied via the read circuits interface directly to the line driver circuits. The line drivers change the signals to computer format and sent these read data to the computer as the CUST RD DATA lines.

2.25.5 In the case of NRZ data, the RD DATA DELAY lines are applied to a buffer register in the read circuits interface. The buffer register stores the data, and during NRZ mode, these data are gated out to the line drivers on the RD DATA OUT lines.

2.25.6 As soon as the first non-ZERO bit in a word is read into the buffer register, the read circuits interface produce a GATE RD CLK which is fed to the read clock circuits. This gate starts the read clock. Depending on whether the MTS is in a read or write mode, and on what the tape density is, a RD CLK is generated after a fixed delay. This RD CLK is applied via the line drivers as the CUST RD CLK to the computer, advising the computer that data are on the CUST READ DATA lines. After a delay, the read clock produces a RD BUFF RESET pulse which resets the buffer register in the read circuits interface to zero, in preparation for the next word.

2.25.7 In this manner, read data from the tape are deskewed and fed simultaneously to the computer. The time delay between the time the first ONE bit is detected, and the time the RD CLK is sent to the computer, is set to insure that any skew effects are compensated for and that all bits in a word being read are detected.

2.25.8 The buffer register in the read circuits interface is disabled during a rewind operation, or when the tape is not loaded (INTL RDY STAT is low), or if the tape is at the BOT marker (–LOAD PT is low).

2.25.9 Threshold Setting Circuits. The threshold setting circuits are controlled by five gates; 808-3 (0280) and 808-11 which operate in write mode, and 808-6, 811-12, and 811-8 which operate in read mode.

2.25.10 When in write mode, the –WR STAT level is low. This low is inverted by inverter 805-4 to form an enabling high to gates 808-3 and 808-11. The low output of inverted 805-10 inhibits gates 808-6, 811-12, and 811-8. Gate 808-3 is enabled by the high output of inverter 805-12 when in PE format (NRZ STAT is low). This provides a low to transistor Q816-16 which cuts off. With Q816-16 cut off, a high level negative threshold voltage is performed at the output of amplifier 832-1 (–THRES).

2.25.11 Gate 808-11 is enabled by the high NRZ STAT level when writing in NRZ format. This provides a low to transistor Q816-13, which cuts off. With transistor Q816-13 cut off, a low level negative threshold (approximately 1/4 of the PE level) voltage is formed at the output of amplifier 832-1.

2.25.12 When in read mode, the –WR STAT level is high. This high is inverted by inverter 805-4 to form a low which inhibits gates 808-3 and 808-11. The high output of inverter 805-10, however, enables gates 808-6, 811-12, and 811-8. Gate 808-6 is enabled by the high output of inverter 805-12 when reading PE format. This provides a low to transistor Q816-6 which cuts off. With Q816-6 cut off, a high level negative threshold (approximately twice the PE write threshold) voltage is formed at the output of amplifier 832-1.

2.25.13 When reading NRZ data, the threshold level is determined by the CUST SET LO RD THRES command from the computer. This command is fed via the line receivers to the read circuits as the CUST LO RD THRES level. When a low threshold level is required, CUST LO RD THRES is high. This high enables gate 811-8 whose other inputs, NRZ STAT and –WR STAT are both high at this time. Gate 811-12 is inhibited by the low output of inverter 805-2. The low output of enabled gate 811-8 cuts off transistors Q16-11. With Q16-11 cut off, a high level negative threshold (the same as for PE write mode) voltage is formed at the output of amplifier 832-1.

2.25.14 When a high threshold level is required, CUST LO RD THRES is low, enabling gate 811-12 and inhibiting 811-8. The low output of enabled gate 811-12 cuts off transistor Q816-3. With Q816-3 cut off, a low level negative threshold (1/2 of the level produced by Q816-11) voltage is formed at the output of 832-1.

2.25.15 The negative threshold level (–THRES) and the positive threshold level (+THRES) from amplifier 832-7 are applied to the peak detector threshold circuits of each of the nine read amplifiers.

2.25.16 Read Amplifer Circuits. Since all nine read amplifier circuits are identical, only read amplifier 1 is described here. Read data from read head 1 (0281) is applied to preamplifier 909-7 which has a gain of approximately 10.

2.25.17 The preamplifier output is applied to an amplifier 924-8. This amplifier consists of two active filter operational amplifier stages. The overall frequency response is a 6-db per octave positive slope for all frequencies up to 500 kHz, and an 18-db octave fall-off for all frequencies above 500 kHz. This approximates the characteristics of a differentiating circuit for all frequencies below approximately 350 kHz. The amplifier contains a gain adjust potentiometer.

2.25.18 The amplifier read data output is applied to positive and negative threshold detector comparators 728-1 and 728-10. These comparators compare the amplifed read data to the threshold level described earlier. If the read data exceeds the positive threshold, a high is applied to gate 711-11. If the read data exceeds the negative threshold, a high is applied to gate 715-3.

2.25.19 The sinusoidal read data are also applied, through emitter follower Q941, to a differentiator amplifier 934-8. The differentiated output is applied to zero-crossing detector 733-1. The zero-crossing signal now coincides with the peak of the input signal and is applied to gate 711-11 along with the positive thresholded signal. The zero-crossing signal is also inverted by 719-2 and applied to gate 715-2 along with the negative thresholded signal. In this manner, detection of either a positive or negative peak of the input data causes both inputs of one of the gates to become enabled, which causes a ONE output from gate 711-3. At the end of the peak, the gate 711-3 output returns to ZERO. A clock pulse is thus generated to single-shot 706-6. The single-shot triggers and remains on until it times out as determined by its external RC time constant. This time constant is a function of whether the MTS is reading in a forward or reverse direction. The single-shot output is the RD DATA DELAY signal which is applied to the buffer register in the read circuit interface. This data signal is used in the NRZ mode.

2.25.20 When reading in forward, –REV CMD is high and the low output of inverter 519-8 turns on transistor Q743 while it holds transistor Q740 off via inverter 519-10. In this manner, the forward read delay potentiometer FD1 may be set for proper skew adjustment. When reading in reverse, transistor Q740 turns on while transistor Q743 turns off due to –REV CMD going low. The reverse read delay potentiometer RD1 may now be set for proper skew adjustment.

2.25.21 When in PE mode, the high output of either the positive or the negative threshold detector comparator is amplified by 733-8 and applied as a low level to inverter 719-12. This inverter produces a high output which is applied to gate 714-12. A second input to gate 724-12 is the zero crossing signal. Gate 724-12 is enabled by the high PE DET level, when in PE mode, and when a bit is detected by the threshold comparator. The resulting low output of gate 724-12 is the RD DATA OUT signal which is applied via the read circuit interface to the line drivers.

2.25.22 READ CIRCUITS INTERFACE. The read circuits interface (0310 and 0311) detects when a character is being read from tape during NRZ mode, and deskews that character in conjunction with the read clock, prior to sending it to the computer via the line drivers.

2.25.23 When a character is read from tape during NRZ mode, the RD DATA DELAY lines are applied in parallel to the 9-stage buffer register (0310) comprising flip-flops 209-5, 9, 214-5, 9, 218-5, 9, 222-5, 9, and 231-5. In any character, there must be at least a single ONE bit. As soon as that ONE bit is applied to its corresponding register stage, the stage is triggered to its ONE stage. The low ZERO output of that stage is inverted by either gate 226-8, 226-6, or 226-12 and inverted again by their corresponding inverters 235-6, 4, or 2 and applied to the read clock gate flip-flop 131-11, 131-3. This low sets the flip-flop producing a high GATE RD CLOCK level which is applied to the read clock.

2.25.24 The GATE RD CLOCK level causes the read clock to operate, producing a RD CLK pulse after a predetermined delay, which is sent to the computer to allow it to accept the data on the CUST RD DATA lines.

2.25.25 From the time the GATE RD CLOCK goes high until the time the RD CLK is generated, the complete data character is read into the buffer register. This time interval is determined so that bits within a character that are skewed on tape, and therefore read at different times, will be stored in the buffer register and placed on the CUST RD DATA lines prior to the RD CLK. In this manner, the effects of skew are compensated.

2.25.26 The buffer register outputs are fed in parallel, via gates enabled by the high NRZ STAT level, to the line drivers. The line drivers place these data on the CUST RD DATA lines. When the RD CLK is sent to the computer, the computer samples the CUST RD DATA lines, reading the character from the MTD.

2.25.27 After a delay, the read clock generates a low −RD BUFF RESET pulse. This pulse is applied via gate 335-8 and inverters 235-10 and 235-12 to the clear direct inputs of each stage of the buffer register, setting the entire register to zero and to the reset side of flip-flop 131-11, 131-3, resetting that flip-flop in preparation for the next character. The high RESET RD CLK output of gate 335-8 is fed back to the read clock, inhibiting the operation of the clock.

2.25.28 The buffer register is clamped to zero by the low outputs of inverters 235-10 and 235-12 when in rewind (−REW MEM is low), when not loaded (INTL RDY STAT is low), or when at the BOT marker (−LOAD PT is low).

2.25.29 READ CLOCK. The read clock (0270) is enabled by the high GATE RD CLK from the read circuits interface when a character is detected at the buffer register. This high enables gate 131-6, producing a low which triggers single-shot 136-6. The high pulse output (pin 6) of the single-shot is inverted to form a low pulse and fed back to gate 131-6, inhibiting it for the width of the pulse. The high-going trailing edge of the pulse then causes the single-shot to fire again. This oscillator circuit produces a square wave output, RD CLK COUNT 0, whose frequency is adjusted by the RCL potentiometer.

2.25.30 The RD CLK COUNT 0 pulses are counted by a four-stage binary counter. The outputs of each stage, RD CLK COUNT 1, 2, 4 and 8, as well as RD CLK COUNT 2 are used to time the delay required before a RD CLK is generated.

2.25.31 When in a write mode, WR STAT is high, enabling gate 122-8 when both RD CLK COUNT 1 and RD CLK COUNT 2 are high. Figure 4-9 illustrates the timing.

2.25.32 When in a read mode, –WR STAT is high, removing the inhibit level from gates 118-6, 118-8, and 122-6. These three gates control the delay for generating the RD CLK depending on the density that the tape was written in. If the computer sends a CUST SET 800 BPI DEN signal to the MTD, causing the line receivers to produce a high DEN 800 signal, gate 109-3 is enabled. The resulting low output of 109-3 is inverted by inverter 114-2 to form a high which is applied to the input of gate 118-6. Gate 118-6 is enabled when RD CLK COUNT 4 is high (see Figure 2-9).

2.25.33 If the computer sends a CUST SET 556 BPI DEN signal to the MTD, causing the line receiver to produce a high DEN 556 signal, gate 109-8 is enabled. The resulting low output of 109-8 is inverted by inverter 114-4 to form a high which is applied to the input of gate 118-8. Gate 118-8 is enabled when RD CLK COUNT 2 and RD CLK COUNT 4 are high (See Figure 2-9), corresponding to count 6 (244).

2.25.34 If neither the CUST SET 800 BPI DEN nor CUST SET 556 BPI DEN signal is set to the MTD, indicating that a 200 bpi density is selected, gate 109-6 is the only gate enabled. (This gate is enabled whenever SEL AUTO & READY is high, but has no effect if either the 800 or 556 bpi density is selected.) The low output of this enabled gate is inverted by inverter 114-6 to form a high which is applied to the input of gate 122-6. Gate 122-6 is enabled when RD CLK COUNT 8 and RD CLK COUNT 4 are high (see Figure 2-9), corresponding to count 12 (8 + 4).

2.25.35 The output of active gate 122-8, 118-6, 118-8, or 122-6 is then applied via inverter 1141-0 to gate 131-8 to enable that gate at the selected read clock count, corresponding to the selected density. The second input to gate 131-8 is RD CLK COUNT 0, which produces an output pulse from enabled gate 131-8. This pulse is the –RD CLK which is fed via the line drivers to the computer, causing the computer to accept the data on the CUST RD DATA lines. The trailing edge of the –RD CLK pulse is also used to trigger single-shot 136-9, producing the –RD BUFF RESET pulse which resets the buffer register after the data are read into the computer.

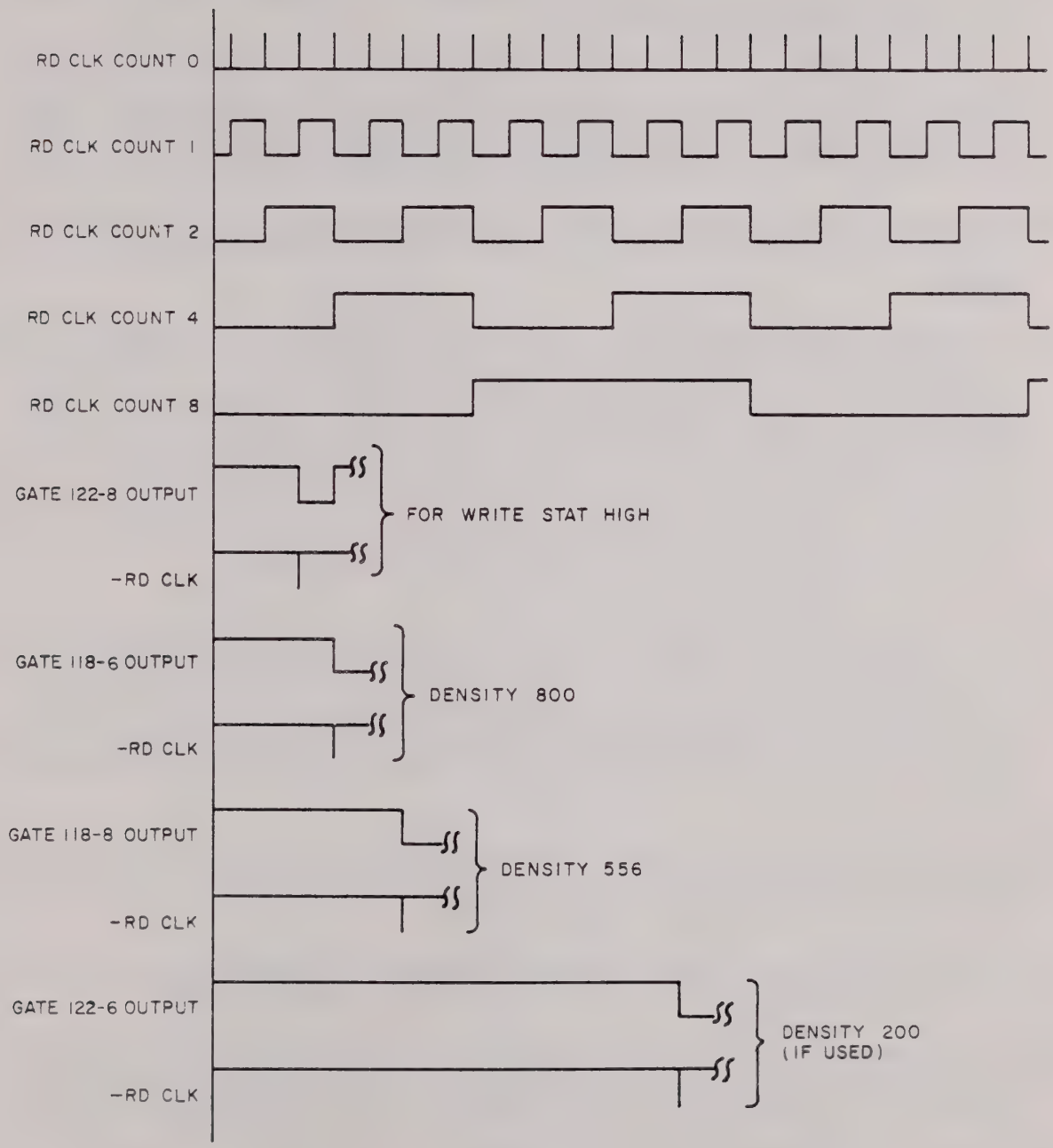

Figure 2-9. Read Clock Timing

2.26 TEST FUNCTION

2.26.1 The MTD has a built-in test circuit which simulates commands required to exercise the various MTD circuits. These circuits are contained on transport logic card (P52). The circuits are activated by five switches also contained on that card.

2.26.2 Motion control commands are issued by operating the Cycle-Run switch (S4) (0120) and the Fwd-Rev switch (S5). If constant motion is required, the Cycle-Run switch is placed in the Run (up) position. This generates a low – RUN level which will activate either the –FWD CMD gate 209-8 or the –REV CMD gate 209-12, depending on the position of Fwd-Rev switch (S5).

2.26.3 If start-stop motion is required, the Cycle run switch (S4) is placed in the Cycle (down) position, causing a square wave to be applied as the –RUN signal. This causes the MTD to run and stop repeatedly.

226.4 When the Fwd-Rev switch (S5) is in the Fwd (down) position, the –RUN signal is inverted by inverter 214-10 and applied to gate 209-8. Gate 209-8 also receives the –TAPE IND signal which is high in forward mode unless the tape is at the EOT indicator. This prevents forward tape motion when at EOT. The third input to gate 209-8 is high when gate 731-8 is enabled. This occurs when the –RDY LITE ON signal is high (MTD not placed under computer control), INTL RDY STAT is high (tape is loaded), –REW MEM is high (MTD not in rewind), and –ACTION INHIBIT is high (no reset and MTD not in unload). The output of enabled gate 209-8 is the –FWD CMD, and is continuously low when in Run, or low and then high in a square-wave pattern when in Cycle. This command is sent to the fwd and rev cmd circuit where it replaces the normally generated –FWD CMD.

2.26.5 When the Fwd-Rev switch (S5) is in the Rev (up) position, the –RUN signal is inverted by inverter 214-12 and applied to gate 209-12. Gate 209-12 receives the –BOT SIG which is high when tape is not at the BOT marker. This prevents reverse tape motion when at BOT. The third input to gate 209-12 is also high when gate 731-8 is enabled, as described earlier. The output of enabled gate 209-12 is the –REV CMD, and is either continuously low when in Run or a square wave when in Cycle. This command is also sent to the fwd and rev cmd circuit where it replaces the normally generated –REV CMD.

2.26.6 To place the MTD in write mode, the Set WR switch (S1) is depressed. This places a low pulse at the input of 131-8, setting flip-flop 131-8, 127-8. With flip-flop 131-8, 127-8 set, the –WR STAT TEST level is low, placing the MTD in a write test mode.

2.26.7 The write clock signal used for write test is generated by an oscillator composed of single-shot 113-10 and inverter 214-8. The frequency of the write clock is adjusted by R140.

2.26.8 The write clock output of the oscillator triggers a four-stage counter consisting of flip-flops 119-12, 119-9, 119-8, and 119-11. The outputs of this counter are used to provide the proper frequency –WR CLK TEST pulses for the high or low density write operation and for NRZ or PE recording modes.

2.26.9 When the PE-NRZ switch (S3) is set for NRZ recording, and the HI-LO switch (S2) is set for LO density, gate 123-12 is enabled by the WR CLK COUNT 8 output of the four-stage counter. This produces a low inverter write clock test square wave (–IWCL) which is inverted by enabled gate 127-6 to form the –WR CLK TEST signal. This signal is applied to the write control circuits, where it replaced the normally-generated WR CLK signal.

2.26.10 If S3 is set to NRZ and S2 is set to HI, gate 123-6 is enabled by the WR CLK COUNT 2 output of the four-stage counter, producing a higher frequency –WR CLK TEST signal.

2.26.11 If S3 is set to PE and S2 set to LO, gate 127-12 is enabled at WR CLK COUNT 1, providing the frequency for the –WR CLK TEST in low density PE mode. If S3 is set to PE and S2 to LO, WR COUNT CLK 0 enables gate 123-8 providing the high density –WR CLK TEST signal in PE mode.

2.26.12 When the PE-NRZ switch is set to PE, a low –PE SW level is applied to the write status, select, and ready circuits, resetting the NRZ status flip-flop. When the switch is in the NRZ position, –PE SW is open circuited, causing the NRZ status flip-flop to be set.

2.26.13 The effect of the various combinations of switch settings for S2 and S3 is summarized as follows:

S2 Position	S3 Position	Density	Pattern
HI	NRZ	800 bpi	All ONEs
LO	NRZ	200 bpi	All ONEs
HI	PE	1600 bpi	All ONEs
LO	PE	–	Alternate ONEs and ZEROs

SIGNAL LIST

ABBR.	FUNCTION	PAGE
AC1 SW	AC Power 1 On	0130
AC 2 SW	AC Power 2 On	0130
ACTION INHIBIT	Action Inhibit	0400
AUTO NOT REW	Auto Not Rewind	0350
BACKUP	Backup	0390
BKWD DET	Backward Detect	0141
BOT CHK	Beginning of Tape Check	0390
BOT LAMP DR	Beginning of Tape Lamp Driver	0450
BOT SENS COL	Beginning of Tape Sensor Collector	0330
BOT SIG	Beginning of Tape Signal	0340
BROKEN TAPE SIG	Broken Tape Signal	0340
CAPSTAN DR V	Capstan Drive Voltage	0490
CAPSTAN MTR DR	Capstan Motor Drive	0500
CART CLO DET	Cartridge Closed Detect	0430
CART MTR CLO DR	Cartridge Motor Close Drive	0430
CART MTR OPEN DR	Cartridge Motor Open Drive	0430
CART OPEN DET	Cartridge Open Detect	0430
CART PRESENT	Cartridge Present	0430
COL VAC	Column Vacuum	0400
COL VAC SET	Column Vacuum Set	0400
CUST ADD SEL LINE 0	Customer Address Select Line 0	0110
CUST BOT RPY	Customer BOT Reply	0320
CUST EOT RPY	Customer EOT Reply	0320
CUST FP RPY	Customer File Protect Reply	0320
CUST LO RD THRES	Customer Low Read Threshold	0141
CUST NRZ STAT RPY	Customer NRZ Status Reply	0320
CUST ON LINE	Customer On Line	0320
CUST RD CLK	Customer Read Clock	0320
CUST RD DATA 1 THRU 9	Customer Read Data 1 through 9	0320
CUST READ STAT	Customer Read Status	0320
CUST RDY	Customer Ready	0320
CUST REV CMD	Customer Reverse Command	0110
CUST REV STAT RPY	Customer Reverse Status Reply	0320
CUST REW CMD	Customer Rewind Command	0110
CUST REW RPY	Customer Rewind Reply	0320
CUST RUN/FWD	Customer Run/Forward	0110
CUST SET LO RD THRES	Customer Set Low Read Threshold	0110
CUST SET NRZ	Customer Set NRZ Mode	0110
CUST SET WR STAT	Customer Set Write Status	0110
CUST SET 556 BPI DEN	Customer Set 556 BPI Density	0110
CUST SET 800 BPI DEN	Customer Set 800 BPI Density	0110
CUST UNLOAD CMD	Customer Unload Command	0110
CUST WR BUS 1 THRU 9	Customer Write Bus 1 through 9	0110
CUST WR CLK	Customer Write Clock	0110
CUST WR LRC CHAR	Customer Write LRC Character	0110
CUST 7TR RPY	Customer 7 Track Reply	0320
DC REF	DC Reference Voltage	0140
DEGAUSS	Degauss	0360
DEN 556	556 BPI Density	0141
DEN 800	800 BPI Density	0141
DOOR INTLK	Door Interlock Switch	0440
EOT LAMP DR	EOT Lamp Driver	0450
EOT SENS COL	EOT Sensor Collector	0330
EOT SIG	End of Tape Signal	0340
EOT/BOT LAMP DET	EOT/BOT Lamp Detect	0330
ERASE HD HI	Erase Head High	0250
ERASE HD LO	Erase Head Low	0250
ERROR RESET	Error Reset	0370
FAN PWR	Fan Power	0440
FP LAMP DR	File Protect Lamp Driver	0260
FP LAMP SIG	File Protect Lamp Signal	0260
FP SIG	File Protect Signal	0260
FWD	Forward	0280

SIGNAL LIST (Cont'd.)

ABBR.	FUNCTION	PAGE
FWD CMD	Forward Command	0120, 0450
GATE RD CLK	Gate Read Clock	0310
GO DET/FWD	Go Detect/Forward	0141
GO INT	Go Internal	0360
H SPEED MEM	High Speed Memory	0420
H SPEED REEL SIG	High Speed Reel Signal	0420
HI CUR DR	High Current Drive	0360
INTL RDY STAT	Internal Ready Status	0400, 0350, 0490
LAMP OUT SIG	Lamp Out Signal	0370
LO NRZ RD	Low NRZ Read	0280
LOAD	Load	0400
LOAD CANCEL	Load Cancel	0370
LOAD CHK LAMP DR	Load Check Lamp Driver	0390
LOAD CHK MEM	Load Check Memory	0390
LOAD CNTR 2, 8, 16, 32	Load Counter Outputs	0390
LOAD PT	Load Point	0450
LOAD SET	Load Set	0400
LOAD SOL DR	Load Solenoid Drive	0440
LOAD/REW	Load/Rewind	0420
LOAD/REW SW	Load/Rewind Signal Switch	0130
LONG LEADER CHECK	Long Leader Check	0390
LOW TAPE SIG	Load Tape Signal	0340
LTP LAMP DET	Low Tape Lamp Detect	0330
LTP SENS COL	Low Tape Sensor Collector	0330
MAS RESET	Master Reset	0371
MID REEL SET	Mid-Reel Set	0400
MTR PWR DR	Motor Power Drive	0440
NORM SERVO ENABLE	Normal Servo Enable	0400
NRZ CUR	NRZ Current	0150
NRZ LOCAL 1, 2, 3	NRZ Status Local Mode	0150
NRZ RD	NRZ Read	0280
NRZ STAT	NRZ Status	0360, 0150
NRZ WR	NRZ Write	0280
PE DET	PE Detect	0280
PE RD	PE Read	0280
PE RD DATA OUT 1 THRU 9	Read Data Out 1 through 9	0280, 0290, 0300, 0310
PE SW	PE Switch Signal	0120
PE WR	PE Write	0280
PE WR CLK	PE Write Clock	0150
POWER UP	Power Up	0370
PWR OFF	Power Off	0370
RAMP	Ramp Signal	0480
RD BUFF RESET	Read Buffer Reset	0270
RD CLK	Read Clock	0270
RD CLK COUNT 0, 1, 2, 4, 8	Read Clock Counter Outputs	0270
RD DATA DELAY 1 THRU 9	Read Data Delay 1 through 9	0280, 0290, 0300
RD DATA FF1 THRU FF9	Read Data Flip Flop Outputs 1 through 9	0310
RDY LAMP DR	READY Lamp Driver	0350
RDY LAMP SIG	READY Lamp Signal	0350
RDY LITE ON	READY Light On	0350
RESET RD CLK	Reset Read Clock	0310
RESET SW	Reset Switch	0130, 0440
RESET WR	Reset Write	0360
RETRY ABORT	Retry Abort	0390
REV	Reverse	0280
REV AT LOAD PT	Reverse at Load Point	0350
REV CMD	Reverse Command	0120, 0450
REV STAT	Reverse Status	0450
REVERSE	Reverse	0450
REVERSE TO BOT	Reverse to Beginning of Tape	0400
REW DET	Rewind Detect	0141
REW H SPEED	Rewind High Speed	0420
REW HI SPEED SIG	Rewind High Speed Signal	0420

ABBR.	FUNCTION	PAGE
REW MEM	Rewind Memory	0420
REW RELAY DR	Rewind Relay Drive	0420
REW/UNLOAD DET	Rewind/Unload Detect	0141
RESET	Reset	0370
RUN	Run (Test)	0120
SAF SENS EM COM	Safety Sensor Emitter Common	0330
SEL AUTO & RDY	Select Auto and Ready	0350
SEL AUTO & RDY A	Select Auto and Ready A	0350
SEL LAMP DR	Select Lamp Driver	0350
SEL RDY & WR STAT	Select Ready and Write Status	0360
SELECT	Select Signal	0141
SELECT FWD	Select Forward	0480
SELECT REV	Select Reverse	0480
SENS EM COM	Sensor Emmitter Common	0330
SERVO AT NULL	Servo at Null	0380
SET NRZ DET	Set NRZ Detect	0141
SET WR STAT DET	Set Write Status Detect	0141
START SW	START Switch Signal	0130
SUP CUR FDBK	Supply Current Feedback	0470
SUP MTR DR	Supply Motor Drive	0470
SUP MTR NORM PWR	Supply Motor Normal Power	0401
SUP MTR RET	Supply Motor Return	0470
SUP TNK LO SAF DET	Supply Tank Lower Safety Detect	0330
SUP TNK LO SAF SENS	Supply Tank Lower Safety Sensor	0330
SUP TNK LO SENS COL	Supply Tank Lower Sensor Collector	0330
SUP TNK LO SENS EM	Supply Tank Lower Sensor Emitter	0330
SUP TNK NULL SENS	Supply Tank Null Sensor	0460
SUP TNK UP SAF DET	Supply Tank Upper Safety Detect	0330
SUP TNK UP SAF SENS	Supply Tank Upper Safety Sensor	0330
SUP TNK UP SENS COL	Supply Tank Upper Sensor Collector	0330
SUP TNK UP SENS EM	Supply Tank Upper Sensor Emitter	0330
SUPPLY MOTOR DRIVE CONTROL	Supply Motor Drive Control	0460
TACH FDBK HI	Tachometer Feedback – High	0500
TACH FDBK LO	Tachometer Feedback – Low	0500
TACH GND	Tachometer Ground	0500
TAKE-UP CUR FDBK	Take-Up Current Feedback	0470
TAKE-UP MOTOR DRIVE CONTROL	Take-Up Motor Drive Control	0460
TAPE CLEANER DR	Tape Cleaner Drive	0440
TAPE IN COL	Tape In Columns	0330
TAPE IND	Tape Indicate	0450
TAPE ON REEL	Tape On Reel	0340
THREAD	Thread	0400
THREAD ENABLE	Thread Enable	0400
THREAD SUP MTR DR	Thread Supply Motor Drive	0401
THREAD TU MTR DR	Thread Take-Up Motor Drive	0401
THRES	Threshold	0280
TNK LAMP 1 DET	Tank Lamp 1 Detect	0330
TNK LAMP 2 DET	Tank Lamp 2 Detect	0330
TOR CHK	Tape On Reel Check	0390
TRANSFER VALVE DR	Transfer Valve Drive	0440
TTP LAMP DET	Tape Threaded Lamp Detect Signal	0330
TTP SENS COL	Tape Threaded Sensor Collector	0330
TU MTR DR	Take-Up Motor Drive	0330, 0470
TU MTR NORM PWR	Take-Up Motor Normal Power	0401
TU MTR RET	Take-Up Motor Return	0470
TU THREAD V	Take-Up Threading Voltage	0460
TU TNK LO SAF DET	Take-Up Tank Lower Safety Detect	
TU TNK LO SAF SENS	Take-Up Tank Low Safety Sensor	0330
TU TNK LO SENS COL	Take-Up Tank Lower Sensor Collector	0330
TU TNK LO SENS EM	Take-Up Tank Lower Sensor Emitter	0330

ABBR.	FUNCTION	PAGE
TU TNK NULL SENS	Take-Up Tank Null Sensor	0460
TU TNK UP SAE DET	Take-Up Tank Upper Safety Detect	0330
TU TNK UP SAF SENS	Take-Up Tank Upper Safety Sensor	0330
TU TNK UP SENS COL	Take-Up Tank Upper Sensor Collector	0330
TU TNK UP SENS EM	Take-Up Tank Upper Sensor Emmiter	0330
TU UNTHREAD V	Take-Up Unthreading Voltage	0460
UNLOAD RESET	Unload Reset	0410
UNLOAD SET	Unload Set	0410
UNLOAD/MEM	Unload Memory	0410
UNLOAD/REW	Unload/Rewind	0410
UNLOAD/REW SW	Unload/Rewind Signal Switch	0130
UNTHREAD	Unthread	0410
UNTHREAD SUP MTR DR	Unthread Supply Motor Drive	0410
UNTHREAD TU MTR DR	Unthread Take-Up Motor Drive	0410
VAC MTR DR	Vacuum Motor Drive	0440
VAC SW	Vacuum Switch Detect	0370
VACUUM LOST	Vacuum Lost Signal	0370
VACUUM LOW	Vacuum Low	0370
WR CHK CHAR	Write Check Character	0140
WR CLK	Write Clock	0140
WR CLK COUNT 0, 1, 2, 8	Write Clock Counter Outputs (Test)	0120
WR CLK LOCAL	Write Clock Local	0150
WR CLK TEST	Write Clock Test	0120
WR CUR SW	Write Current Switch	0260
WR DATA 1 THRU 9	Write Data 1 through 9	0140
WR DATA 1 THRU 9 DELAYED	Write Data 1 through 9 Delayed	0160, 0180 0200, 0220, 0240
WR LONG CHK CHAR	Write Longitudinal Check Character	0150
WR PW SW	Write Power Switch	0170
WR STAT	Write Status	0350
WR STAT DR	Write Status Drive	0360, 0150
WR STAT TEST	Write Status Test	0120
ZERO DETECT	Zero Detect	0480
7TR	7 Track	0320

LOGIC SYMBOLS

THE FUNCTION SYMBOLS USED IN THE LOGIC DIAGRAMS ARE AS FOLLOWS

A – – – – AND FUNCTION
O – – – – OR FUNCTION
I – – – – INVERTER
FF – – – – FLIP FLOP
LD – – – – LINE DRIVER
LR – – – – LINE RECEIVER
PS – – – – PULSE SHAPER
TD – – – – TIME DELAY
LC – – – – LEVEL CONVERTER
SD – – – LAMP OR SOLENOID DRIVER
SS – – – SINGLE SHOT
DOT – – – DIODE OR TIE
AR – – – AMPLIFIER
OSC – – – OSCILLATOR
FIL – – – FILTER
RXX – – – POTENTIOMETER
QXXX – – – TRANSISTOR STAGE

NOTE:

The following logics pages are for use as a maintenance aid only. Refer to PCB schematics for the latest circuitry and exact details.

SYMBOL DEFINITION

A — FUNCTION SYMBOL
510 — COMPONENT LOCATION
LC — CARD TYPE

● TEST POINT

◇ CIRCUIT TIE POINT

◺ ACTIVE LEVEL OF THIS LINE IS 0 VOLTS

CARD TYPE	DESCRIPTION	LOCATION
LC	TRANSPORT LOGIC CONTROL	P52
WA	WRITE AMPLIFIER	P53
RA	READ AMPLIFIER	P51
AC	AMPLIFIER INTERFACE	P57
LR/LD	LINE RECEIVERS & DRIVERS	P58
A2	REGULATOR SUPPLIES	A2
A3	REEL & CAPSTAN CONTROL	A3
J/P 55	TRANSPORT HARNESS	
J/P 59	I/O HARNESS	

DIAGRAM NO.	TITLE	PAGE NO.
0110	Interface Connector for Nine Track MTD	2-46
0111	Interface Connector for Seven Track MTD	2-47
0120	Test Function	2-48
0130	Control Panel	2-49
0140	Line Receivers	2-50
0141	Line Receivers	2-51
0150	Write Circuit Controls	2-52
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REVISION DESCRIPTION	ZONE	ECO NO	APPROVED BY	DATE	LTR
					A

SIG	GND	MNEMONIC	SIG NAME	PAGE	J/P59 I/O HARNESS
B1	A1	CREV	CUST REV CMD	0141	J/P59-37
B3	B2	CRWD	CUST REW CMD	0141	39
B5	B4	CURD	CUST UNLOAD CMD	0141	41
C2	C3	CRUN	CUST RUN/FWD	0141	43
D3	D2	CSNRZ	CUST SET NRZ	0141	45
D5	D4	CWST	CUST SET WR STAT	0141	47
E2	E3	CLRT	CUST SET LO RD THRES	0141	49
E4	E5	CS800	CUST SET 800 BPI DEN	0141	51
F1	E1	SELO	CUST ADD SEL LINE 0	0141	53
F3	F2	CS556	CUST SET 556 BPI DEN	0141	81
F5	F4	CRDY	CUST RDY	0320	35
G2	G3	SEL1	CUST ADD SEL LINE 1	0141	
G4	G5	SEL2	CUST ADD SEL LINE 2	0141	
H1	G1	SEL 6	CUST ADD SEL LINE 6	0141	
H3	H2	SEL 7	CUST ADD SEL LINE 7	0141	
H5	H4	SEL 3	CUST ADD SEL LINE 3	0141	
J2	J3	SEL 5	CUST ADD SEL LINE 5	0141	
J4	J5	SEL 4	CUST ADD SEL LINE 4	0141	
K1	J1	CBTR	CUST BOT RPY	0320	15
K3	K2	CRRS	CUST READ STAT	0320	17
K5	K4	CONL	CUST ON LINE	0320	19
L2	L3	CRVR	CUST REV STAT RPY	0320	21
L4	L5	CETR	CUST EOT RPY	0320	23
M1	L1	CFPR	CUST FP RPY	0320	25
M3	M2	CRWR	CUST REW RPY	0320	27
M5	M4	CNRZR	CUST NRZ STAT RPY	0320	29
N2	N3	C7TR	CUST 7TR RPY	0320	31
R4	R5	SPARE 3	——	——	79
S3	S4	SPARE 1	——	——	77
T1	U1	CRD2	CUST RD DATA 2	0320	33
T3	T2	CRD1	CUST RD DATA 1	0320	83
T4		+5V	——	——	3
T5		GND	——	——	10
U2	U3	CRD3	CUST RD DATA 3	0320	85
U4	U5	CRD4	CUST RD DATA 4	0320	87
V1	W1	CRD7	CUST RD DATA 7	0320	89
V3	V2	CRD6	CUST RD DATA 6	0320	91
V5	V4	CRD5	CUST RD DATA 5	0320	93
W2	W3	CRD8	CUST RD DATA 8	0320	95
W4	W5	CRD9	CUST RD DATA 9	0320	97
X3	X2	CRCK	CUST RD CLK	0320	99
Y4	Y5	CWB1	CUST WR BUS 1	0140	55
Z1	a1	CWB4	CUST WR BUS 4	0140	57
Z3	Z2	CWB3	CUST WR BUS 3	0140	59
Z5	Z4	CWB2	CUST WR BUS 2	0140	61
a2	a3	CWB5	CUST WR BUS 5	0140	63
a4	a5	CWB6	CUST WR BUS 6	0140	65
b1	c1	CWB9	CUST WR BUS 9	0140	67
b3	b2	CWB8	CUST WR BUS 8	0140	69
b5	b4	CWB7	CUST WR BUS 7	0140	71
c2	c3	CWCK	CUST WR CLK	0140	73
c4	c5	CWLC	CUST WR LRC CHAR	0140	J/P59-75

6	5	4	3	2	1
A	A	A	A	A	A GND
B	B CURD	B GND	B CRWD	B GND	B CREV
C	C	C	C GND	C CRUN	C
D	D CWST	D GND	D CSNRZ	D GND	D
E	E GND	E CS800	E GND	E CLRT	E GND
F	F CRDY	F GND	F CS556	F GND	F SELO
G	G GND	G SEL2	G GND	G SEL1	G GND
H	H SEL3	H GND	H SEL7	H GND	H SEL6
J	J GND	J SEL4	J GND	J SEL5	J GND
K	K CONL	K GND	K CRRS	K GND	K CBTR
L	L GND	L CETR	L GND	L CRVR	L GND
M	M CNRZR	M GND	M CRWR	M GND	M CFPR
N	N	N	N GND	N C7TR	N

REAR VIEW

P	P	P	P	P	P
R	R GND	R SPARE 3	R	R	R
S	S	S GND	S SPARE 2	S	S
T	T +5V	T +5V	T CRD1	T GND	T CRD2
U	U GND	U CRD4	U GND	U CRD3	U GND
V	V CRD5	V GND	V CRD6	V GND	V CRD7
W	W GND	W CRD9	W GND	W CRD8	W GND
X	X	X	X CRCK	X GND	X
Y	Y GND	Y CWB1	Y	Y	Y
Z	Z CWB2	Z GND	Z CWB3	Z GND	Z CWB4
a	a GND	a CWB6	a GND	a CWB5	a GND
b	b CWB7	b GND	b CWB8	b GND	b CWB9
c	c GND	c CWLC	c GND	c CWCK	c GND

INTERFACE CONNECTOR
J23 & J24
0110

REVISION DESCRIPTION	ZONE	ECO NO	APPROVED BY	DATE	LTR
					B

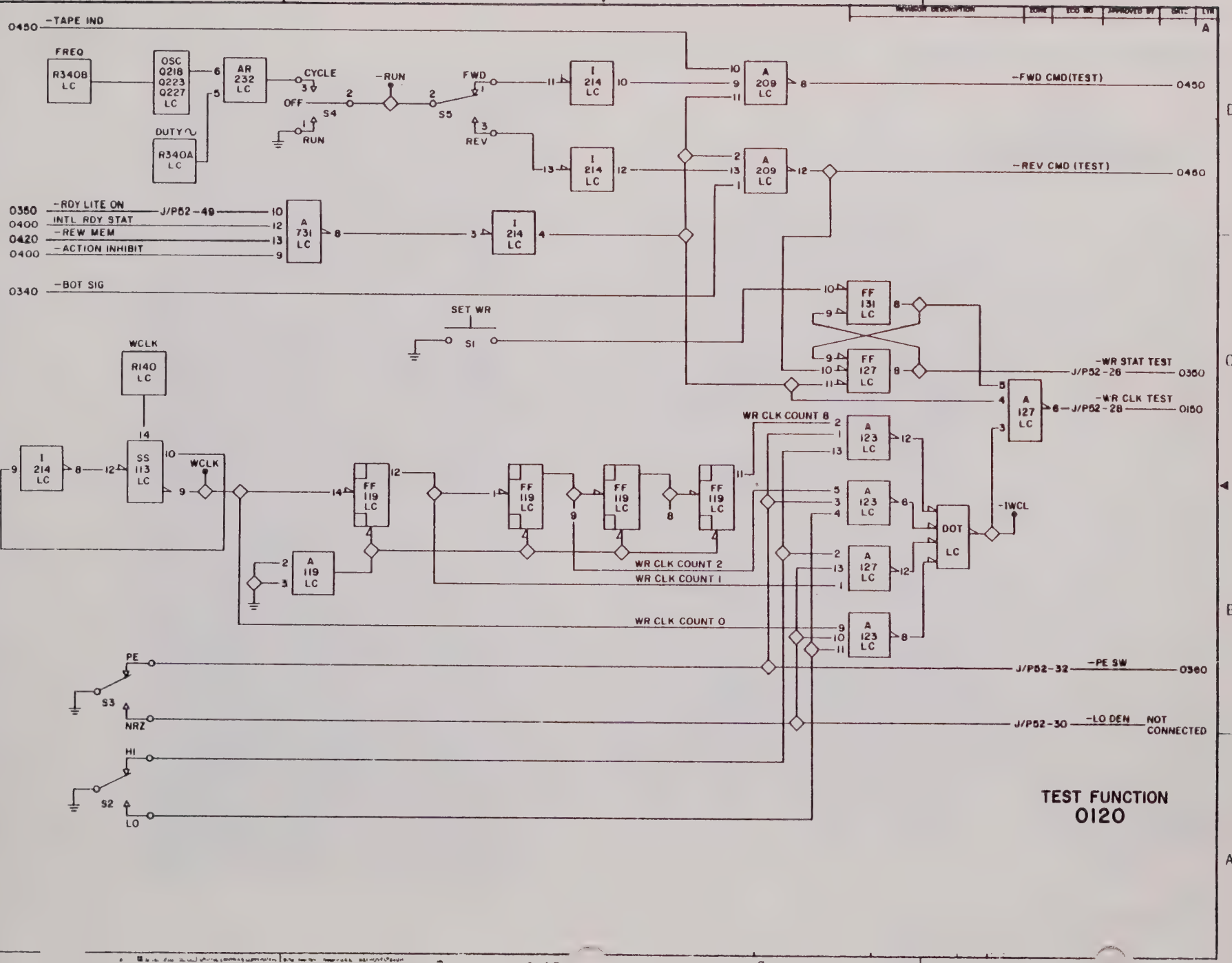
SIG	GND	MNEMONIC	SIG NAME	PAGE	J/P59 I/O HARNESS
B1	A1	CREV	CUST REV CMD	0141	J/P59 37
B3	B2	CRWD	CUST REW CMD	0141	39
B5	B4	CURD	CUST UNLOAD CMD	0141	41
C2	C3	CRUN	CUST RUN/FWD	0141	43
D3	D2	CSNRZ	CUST SET NRZ	0141	45
D5	D4	CWST	CUST SET WR STAT	0141	47
E2	E3	CLRT	CUST SET LO RD THRES	0141	49
E4	E5	CS800	CUST SET 800 BPI DEN	0141	51
F1	E1	SEL0	CUST ADD SEL LINE 0	0141	53
F3	F2	CS556	CUST SET 556 BPI DEN	0141	81
F5	F4	CRDY	CUST RDY	0320	35
G2	G3	SEL1	CUST ADD SEL LINE 1	0141	
G4	G5	SEL2	CUST ADD SEL LINE 2	0141	
H1	G1	SEL 6	CUST ADD SEL LINE 6	0141	
H3	H2	SEL 7	CUST ADD SEL LINE 7	0141	
H5	H4	SEL 3	CUST ADD SEL LINE 3	0141	
J2	J3	SEL 5	CUST ADD SEL LINE 5	0141	
J4	J5	SEL 4	CUST ADD SEL LINE 4	0141	
K1	J1	CBTR	CUST BOT RPY	0320	15
K3	K2	CRRS	CUST READ STAT	0320	17
K5	K4	CONL	CUST ON LINE	0320	19
L2	L3	CRVR	CUST REV STAT RPY	0320	21
L4	L5	CETR	CUST EOT RPY	0320	23
M1	L1	CFPR	CUST FP RPY	0320	25
M3	M2	CRWR	CUST REW RPY	0320	27
M5	M4	CNRZR	CUST NRZ STAT RPY	0320	29
N2	N3	C7TR	CUST 7TR RPY	0320	31
R4	R5	SPARE 3	— —	——	79
S3	S4	SPARE 1	— —	——	77
T1	U1	CRD2	CUST RD DATA 2	0320	93
T3	T2	CRD1	CUST RD DATA 1	0320	91
T4		+5V	——	——	3
T5		GND	— —	——	10
U2	U3	CRD3	CUST RD DATA 3	0320	89
U4	U5	CRD4	CUST RD DATA 4	0320	83
V1	W1	CRD7	CUST RD DATA 7	0320	95
V3	V2	CRD6	CUST RD DATA 6	0320	33
V5	V4	CRD5	CUST RD DATA 5	0320	97
W2	W3				
W4	W5				
X3	X2	CRCK	CUST RD CLK	0320	99
Y4	Y5	CWB1	CUST WR BUS 1	0140	65
Z1	a1	CWB4	CUST WR BUS 4	0140	55
Z3	Z2	CWB3	CUST WR BUS 3	0140	71
Z5	Z4	CWB2	CUST WR BUS 2	0140	63
a2	a3	CWB5	CUST WR BUS 5	0140	67
a4	a5	CWB6	CUST WR BUS 6	0140	61
b1	c1				
b3	b2				
b5	b4	CWB7	CUST WR BUS 7	0140	69
c2	c3	CWCK	CUST WR CLK	0140	73
c4	c5	CWLC	CUST WR LRC CHAR	0140	J/P59 - 75

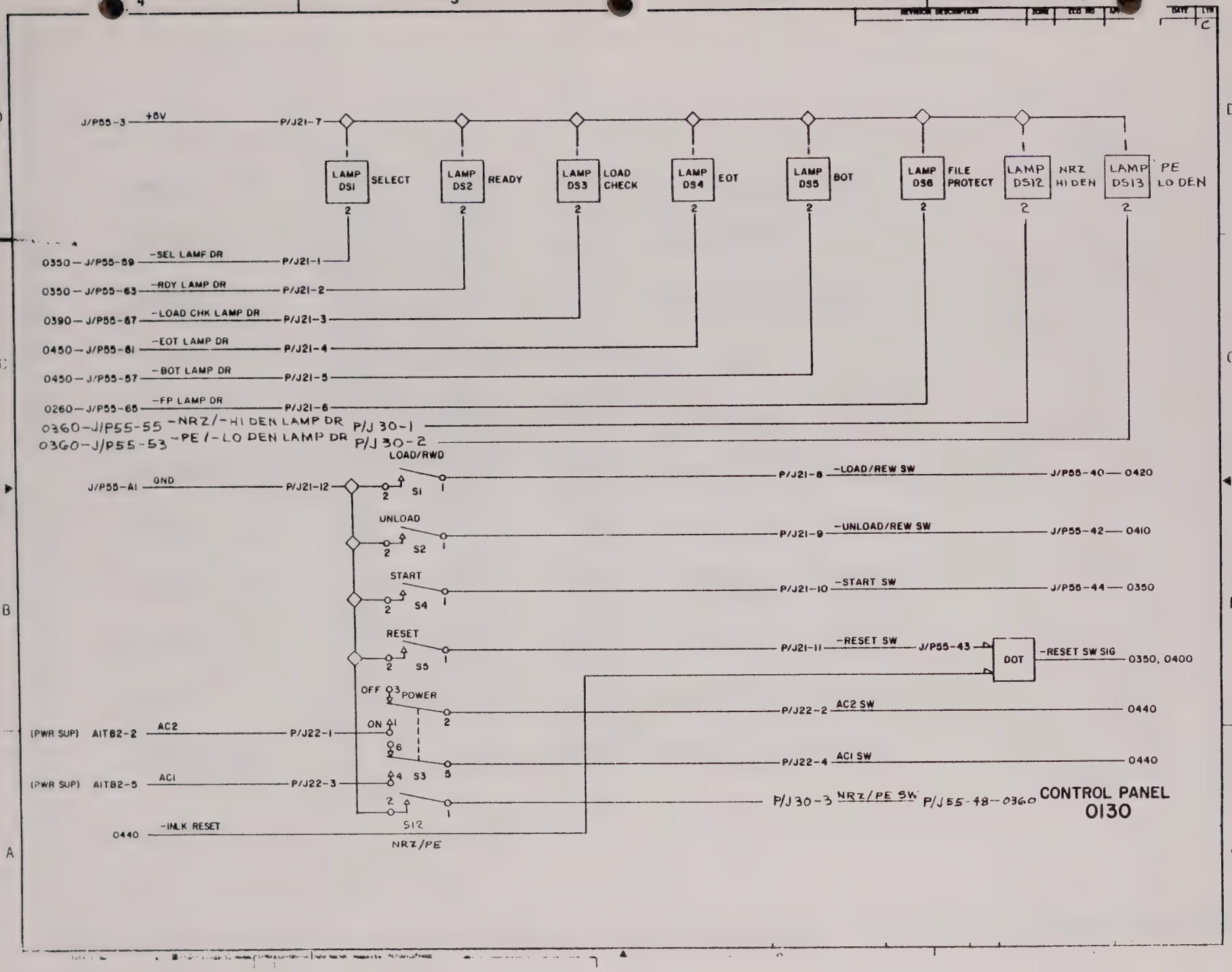
6	5	4	3	2	1
A	A	A	A	A	A GND
B	B CURD	B GND	B CRWD	B GND	B CREV
C	C	C	C GND	C CRUN	C
D	D CWST	D GND	D CSNRZ	D GND	D
E	E GND	E CS800	E GND	E CLRT	E GND
F	F CRDY	F GND	F CS556	F GND	F SEL0
G	G GND	G SEL2	G GND	G SEL1	G GND
H	H SEL3	H GND	H SEL7	H GND	H SEL6
J	J GND	J SEL4	J GND	J SEL5	J GND
K	K CONL	K GND	K CRRS	K GND	K CBTR
L	L GND	L CETR	L GND	L CRVR	L GND
M	M CNRZR	M GND	M CRWR	M GND	M CFPR
N	N	N	N GND	N C7TR	N

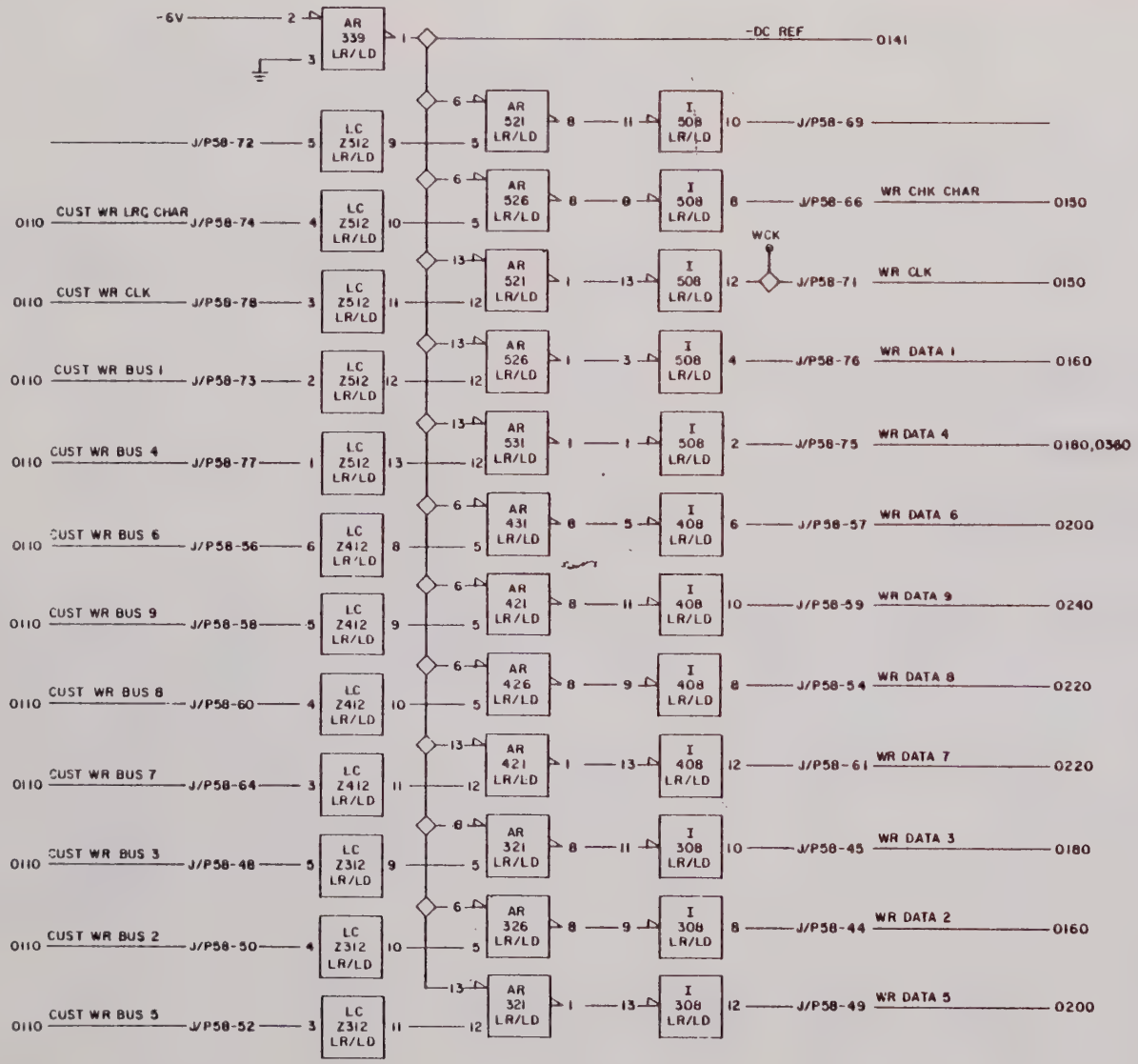
REAR VIEW

P	P	P	P	P	P
R	R GND	R SPARE 3	R	R	R
S	S	S GND	S SPARE 2	S	S
T	T +5V	T +5V	T CRD1	T GND	T CRD2
U	U GND	U CRD4	U GND	U CRD3	U GND
V	V CRD5	V GND	V CRD6	V GND	V CRD7
W	W	W	W	W	W GND
X	X	X	X CRCK	X GND	X
Y	Y GND	Y CWB1	Y	Y	Y
Z	Z CWB2	Z GND	Z CWB3	Z GND	Z CWB4
a	a GND	a CWB6	a GND	a CWB5	a GND
b	b CWB7	b GND	b	b	b
c	c GND	c CWLC	c GND	c CWCK	c

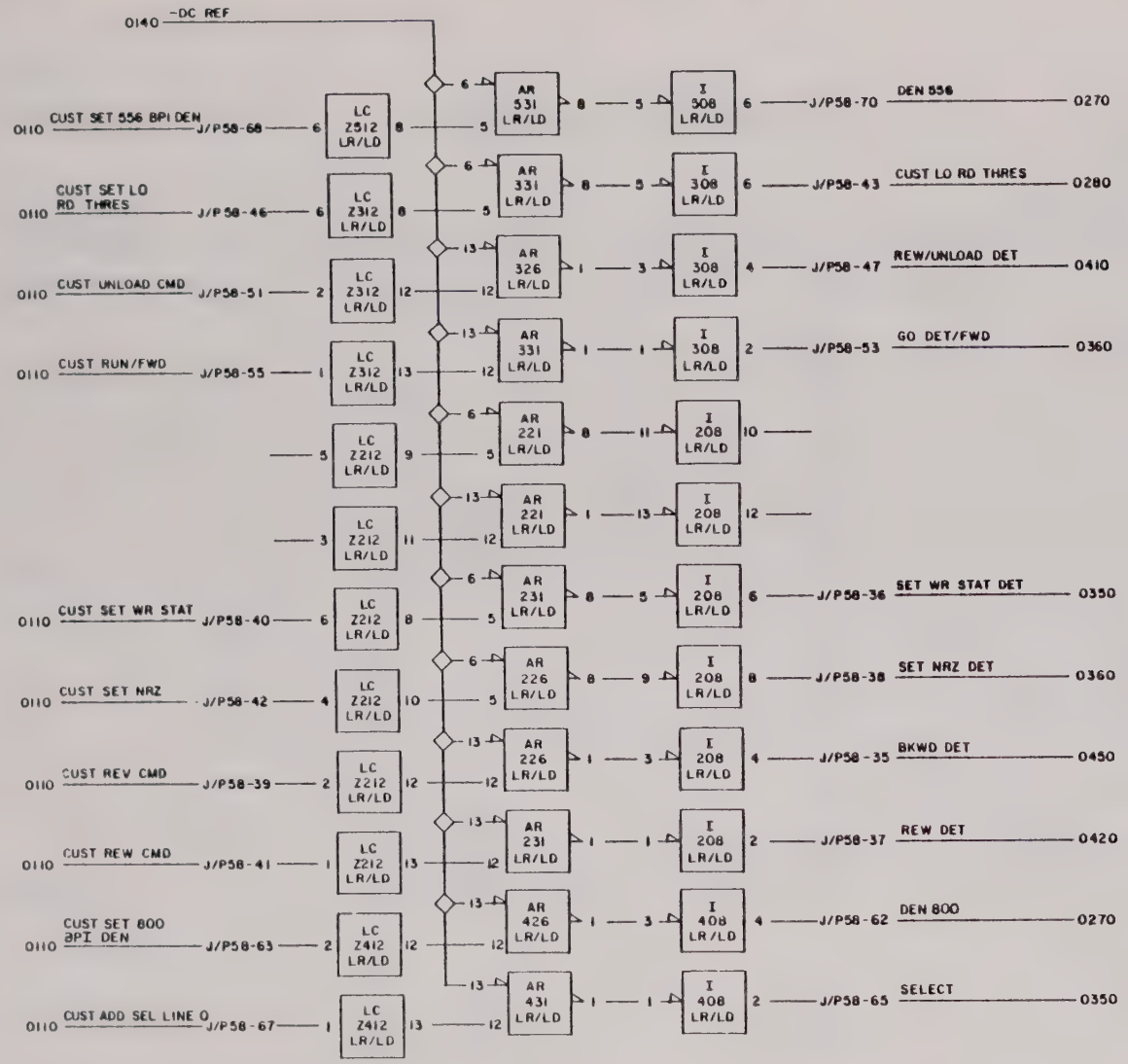
INTERFACE CONNECTOR
J23 & J24
0111


0450 -TAPE IND
FREQ
R340B LC
OSC 0218 0223 0227 LC
AR 232 LC
CYCLE
OFF
S4
-RUN
S5
FWD
REV
RUN
DUTY
R340A LC
I 214 LC
A 209 LC
-FWD CMD(TEST) 0450
-REV CMD (TEST) 0460
0380 -RDY LITE ON J/P52-49
0400 INTL RDY STAT
0420 -REW MEM
0400 -ACTION INHIBIT
A 731 LC
0340 -BOT SIG
SET WR
S1
FF 131 LC
FF 127 LC
-WR STAT TEST J/P52-26 0350
-WR CLK TEST J/P52-28 0150
A 127 LC
WCLK
R140 LC
SS 113 LC
FF 119 LC
A 119 LC
WR CLK COUNT 8
WR CLK COUNT 2
WR CLK COUNT 1
WR CLK COUNT 0
A 123 LC
DOT LC
-IWCL
PE
S3
NRZ
HI
S2
LO
J/P52-32 -PE SW 0360
J/P52-30 -LO DEN NOT CONNECTED
TEST FUNCTION 0120


J/P55-3 +5V
P/J21-7
LAMP DS1 SELECT
LAMP DS2 READY
LAMP DS3 LOAD CHECK
LAMP DS4 EOT
LAMP DS5 BOT
LAMP DS6 FILE PROTECT
LAMP DS12 NRZ HI DEN
LAMP DS13 PE LO DEN
0350 — J/P55-59 -SEL LAMP DR P/J21-1
0350 — J/P55-63 -RDY LAMP DR P/J21-2
0390 — J/P55-67 -LOAD CHK LAMP DR P/J21-3
0450 — J/P55-61 -EOT LAMP DR P/J21-4
0450 — J/P55-57 -BOT LAMP DR P/J21-5
0260 — J/P55-65 -FP LAMP DR P/J21-6
0360 — J/P55-55 -NRZ/-HI DEN LAMP DR P/J 30-1
0360 — J/P55-53 -PE/-LO DEN LAMP DR P/J 30-2
J/P55-A1 GND
P/J21-12
LOAD/RWD
S1
P/J21-8 -LOAD/REW SW J/P55-40 — 0420
UNLOAD
S2
P/J21-9 -UNLOAD/REW SW J/P55-42 — 0410
START
S4
P/J21-10 -START SW J/P55-44 — 0350
RESET
S5
P/J21-11 -RESET SW J/P55-43
DOT
-RESET SW SIG 0350, 0400
OFF
POWER
S3
ON
P/J22-2 AC2 SW 0440
(PWR SUP) AITB2-2 AC2 P/J22-1
P/J22-4 AC1 SW 0440
(PWR SUP) AITB2-5 AC1 P/J22-3
P/J30-3 NRZ/PE SW P/J55-48 — 0360
S12
NRZ/PE
0440 -INLK RESET
CONTROL PANEL
0130

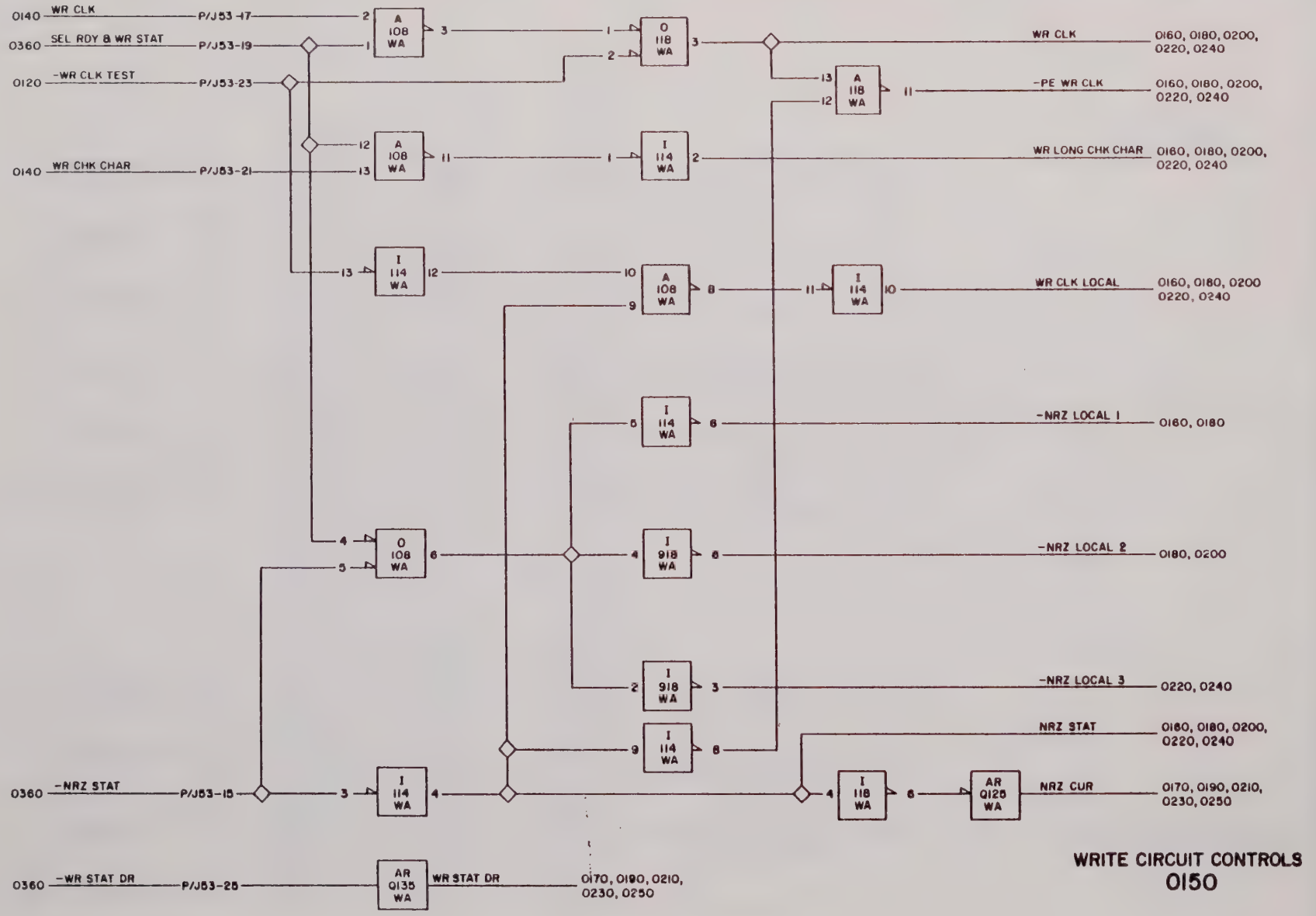


LINE RECEIVERS
0140

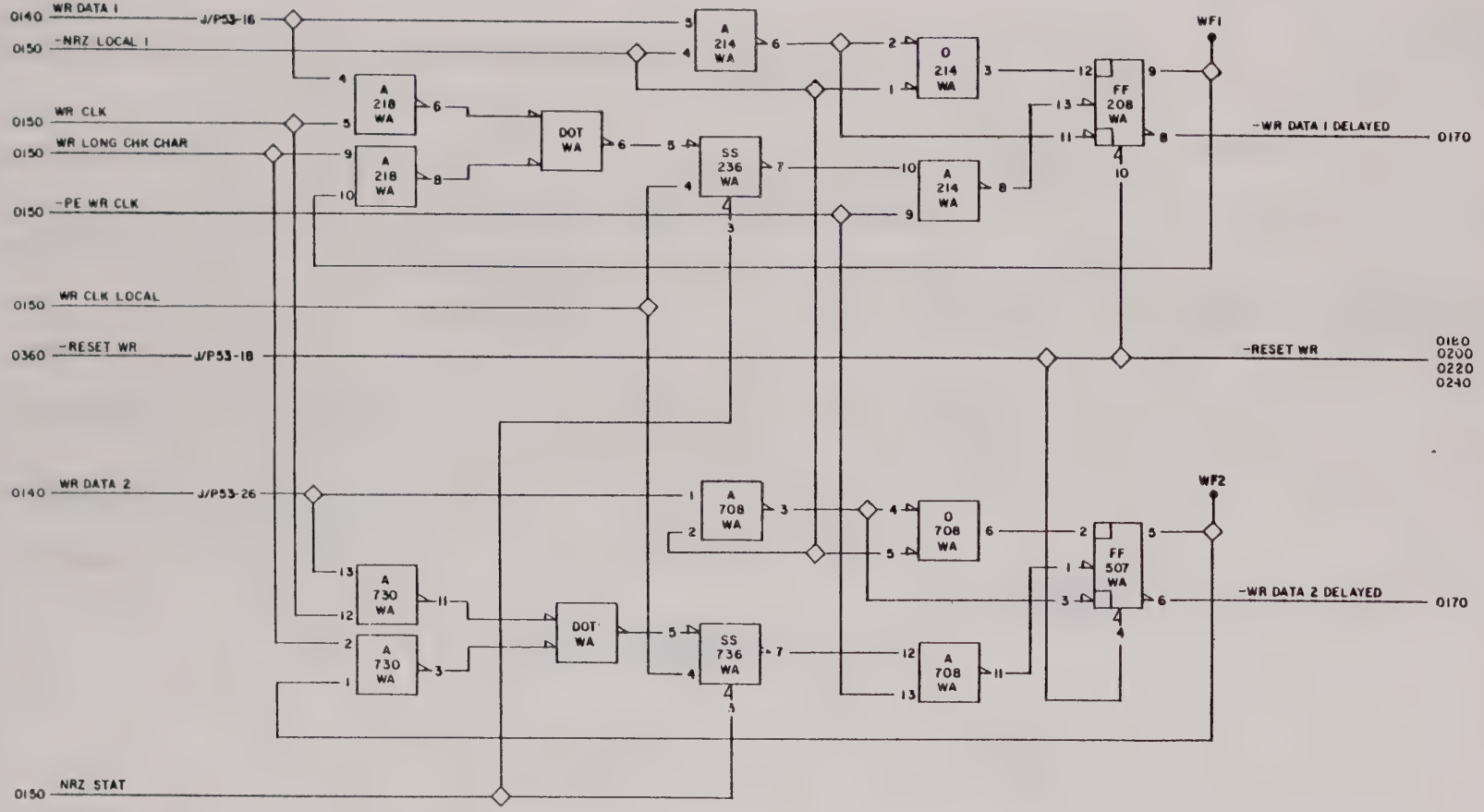

0140 -DC REF
0110 CUST SET 556 BPI DEN J/P58-68
0110 CUST SET LO RD THRES J/P58-46
0110 CUST UNLOAD CMD J/P58-51
0110 CUST RUN/FWD J/P58-55
0110 CUST SET WR STAT J/P58-40
0110 CUST SET NRZ J/P58-42
0110 CUST REV CMD J/P58-39
0110 CUST REW CMD J/P58-41
0110 CUST SET 800 BPI DEN J/P58-63
0110 CUST ADD SEL LINE 0 J/P58-67
LC Z512 LR/LD
LC Z312 LR/LD
LC Z212 LR/LD
LC Z412 LR/LD
AR 531 LR/LD
AR 331 LR/LD
AR 326 LR/LD
AR 221 LR/LD
AR 231 LR/LD
AR 226 LR/LD
AR 426 LR/LD
AR 431 LR/LD
I 308 LR/LD
I 208 LR/LD
I 408 LR/LD
J/P58-70 DEN 556 0270
J/P58-43 CUST LO RD THRES 0280
J/P58-47 REW/UNLOAD DET 0410
J/P58-53 GO DET/FWD 0360
J/P58-36 SET WR STAT DET 0350
J/P58-38 SET NRZ DET 0360
J/P58-35 BKWD DET 0450
J/P58-37 REW DET 0420
J/P58-62 DEN 800 0270
J/P58-65 SELECT 0350

LINE RECEIVERS
0141

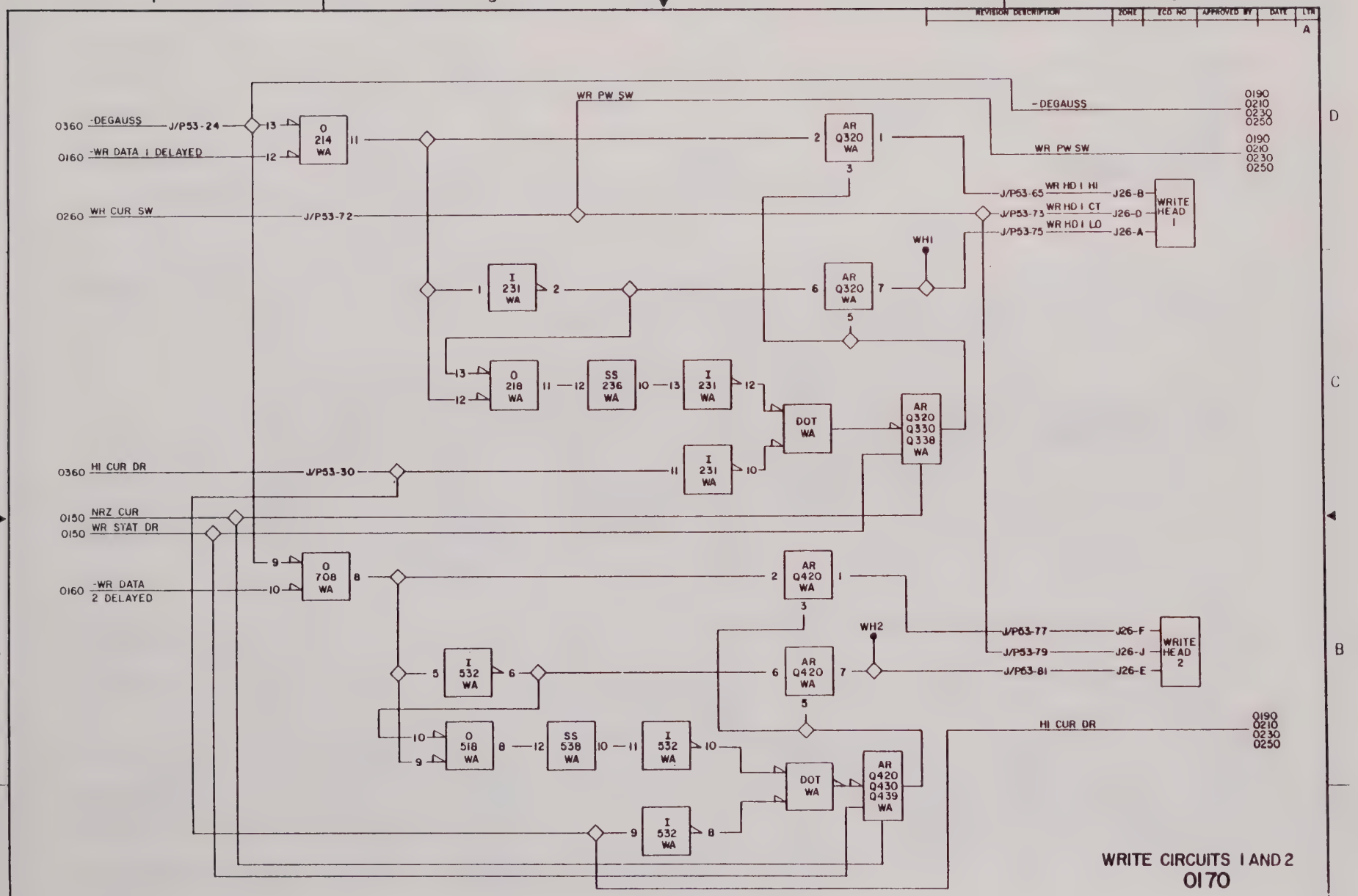
REVISION DESCRIPTION	ZONE	ECO NO	APPROVED BY	DATE	LTR
					A

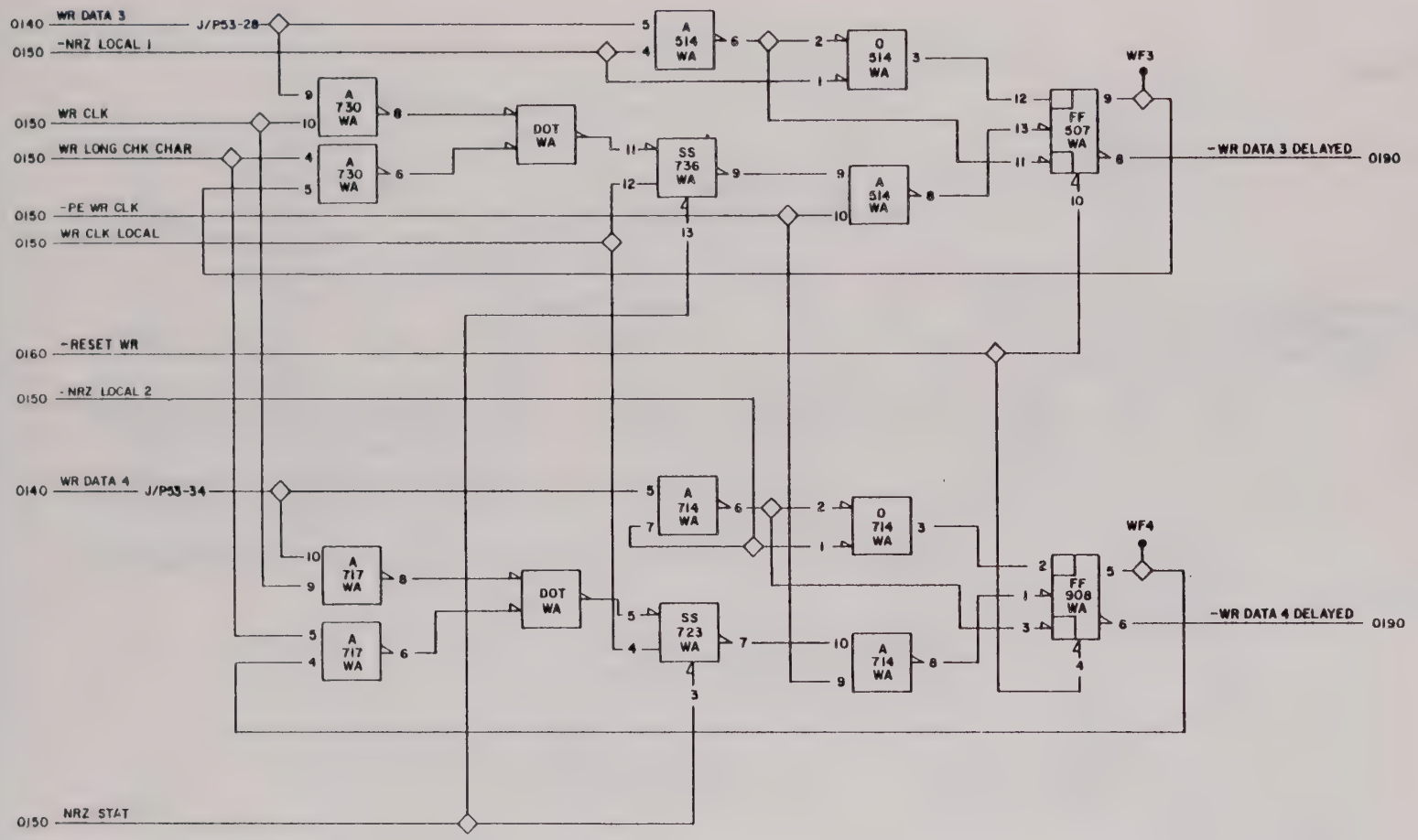


WRITE CIRCUIT CONTROLS
0150

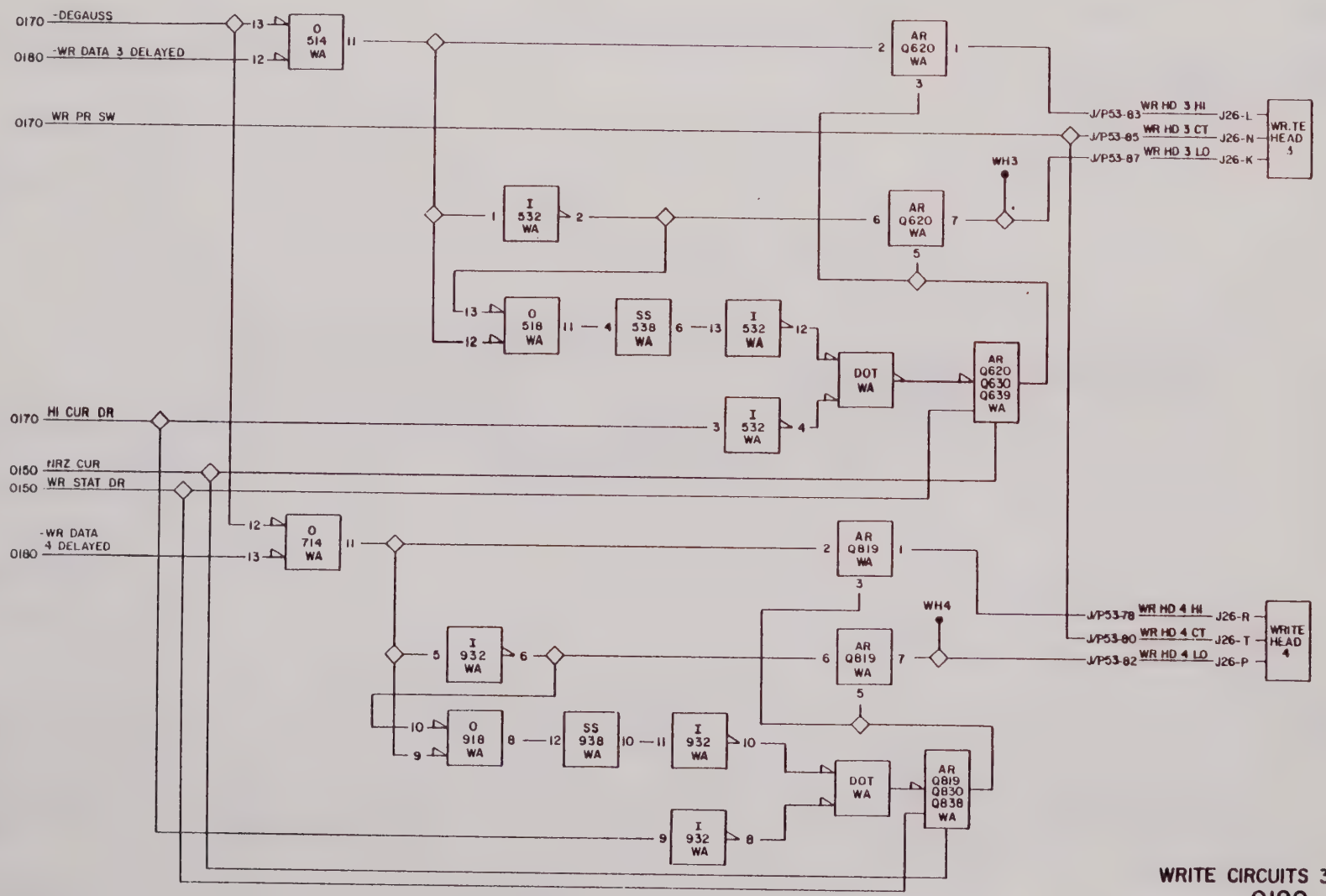


WRITE CIRCUITS 1 AND 2
0160

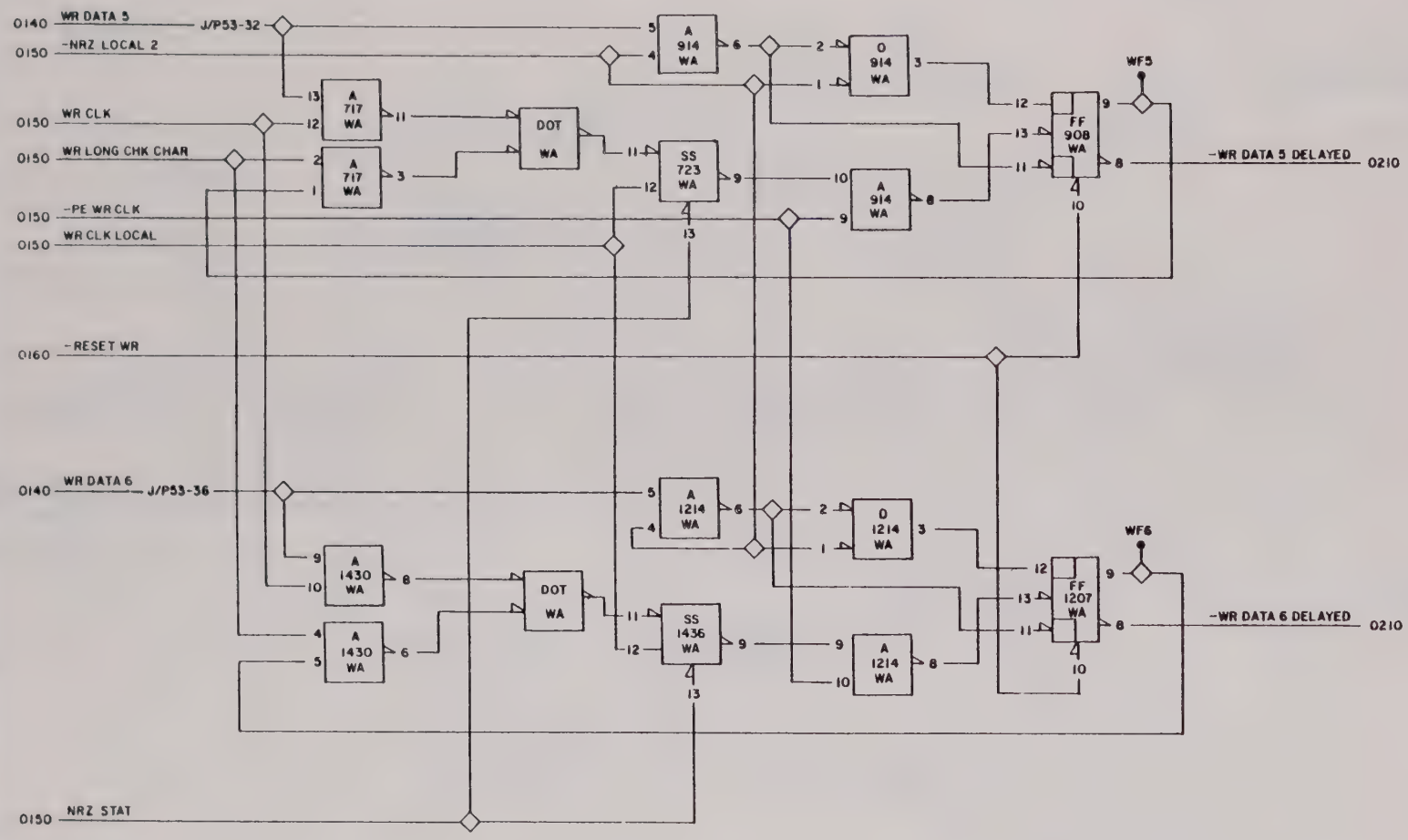

4
3
2
1
REVISION DESCRIPTION
ZONE
ECO NO
APPROVED BY
DATE
LTR
A
0360 -DEGAUSS J/P53-24
0160 -WR DATA 1 DELAYED
0260 WH CUR SW J/P53-72
0360 HI CUR DR J/P53-30
0150 NRZ CUR
0150 WR STAT DR
0160 -WR DATA 2 DELAYED
WR PW SW
-DEGAUSS
0190 0210 0230 0250
WR PW SW
0190 0210 0230 0250
J/P53-65 WR HD 1 HI J26-B
J/P53-73 WR HD 1 CT J26-D
J/P53-75 WR HD 1 LO J26-A
WRITE HEAD 1
J/P53-77 J26-F
J/P53-79 J26-J
J/P53-81 J26-E
WRITE HEAD 2
WH1
WH2
0 214 WA
I 231 WA
AR Q320 WA
0 218 WA
SS 236 WA
DOT WA
AR Q320 Q330 Q338 WA
0 708 WA
AR Q420 WA
I 532 WA
0 518 WA
SS 538 WA
AR Q420 Q430 Q439 WA
HI CUR DR
0190 0210 0230 0250
WRITE CIRCUITS 1 AND 2
0170
2-54



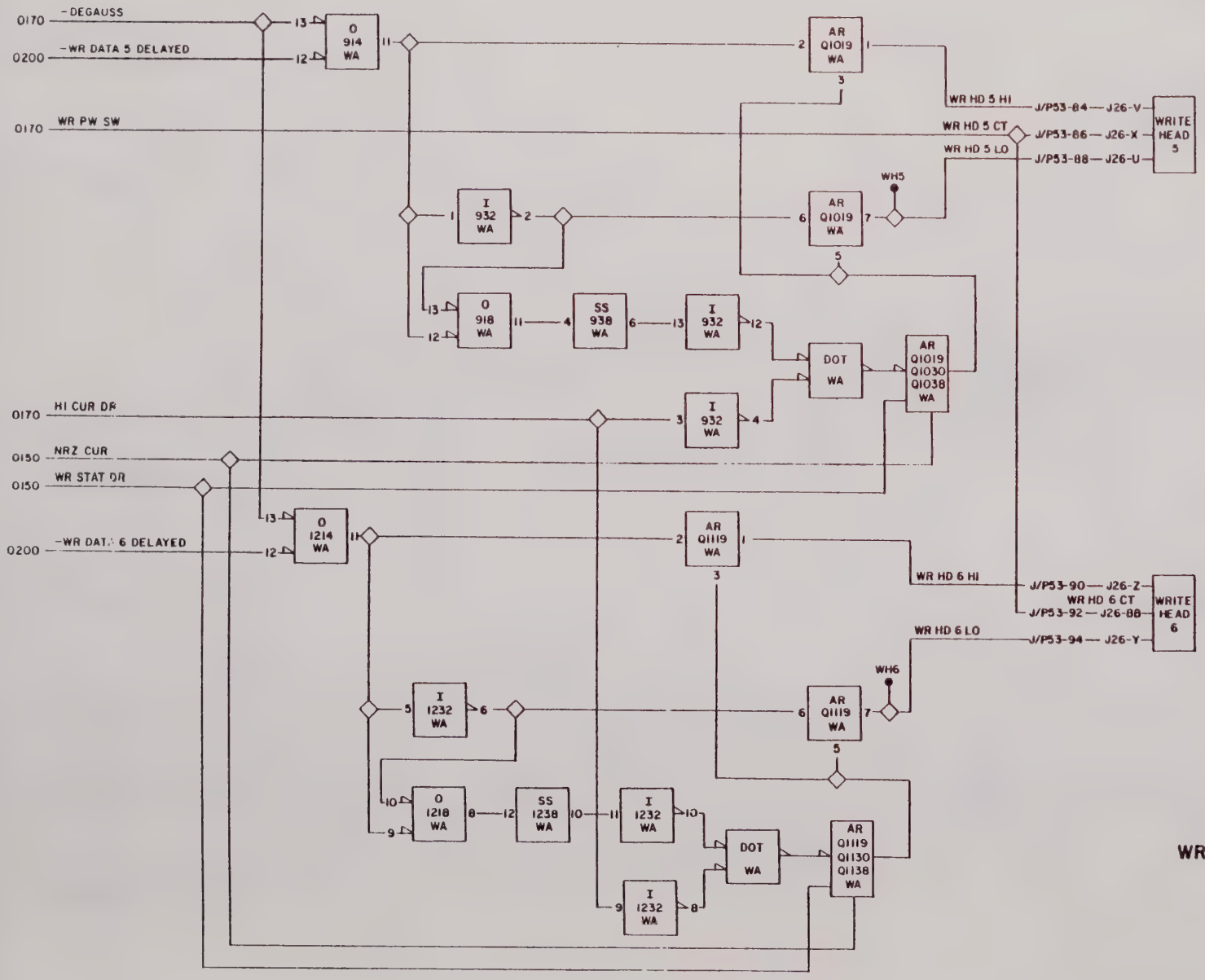
WRITE CIRCUITS 3 AND 4
0180

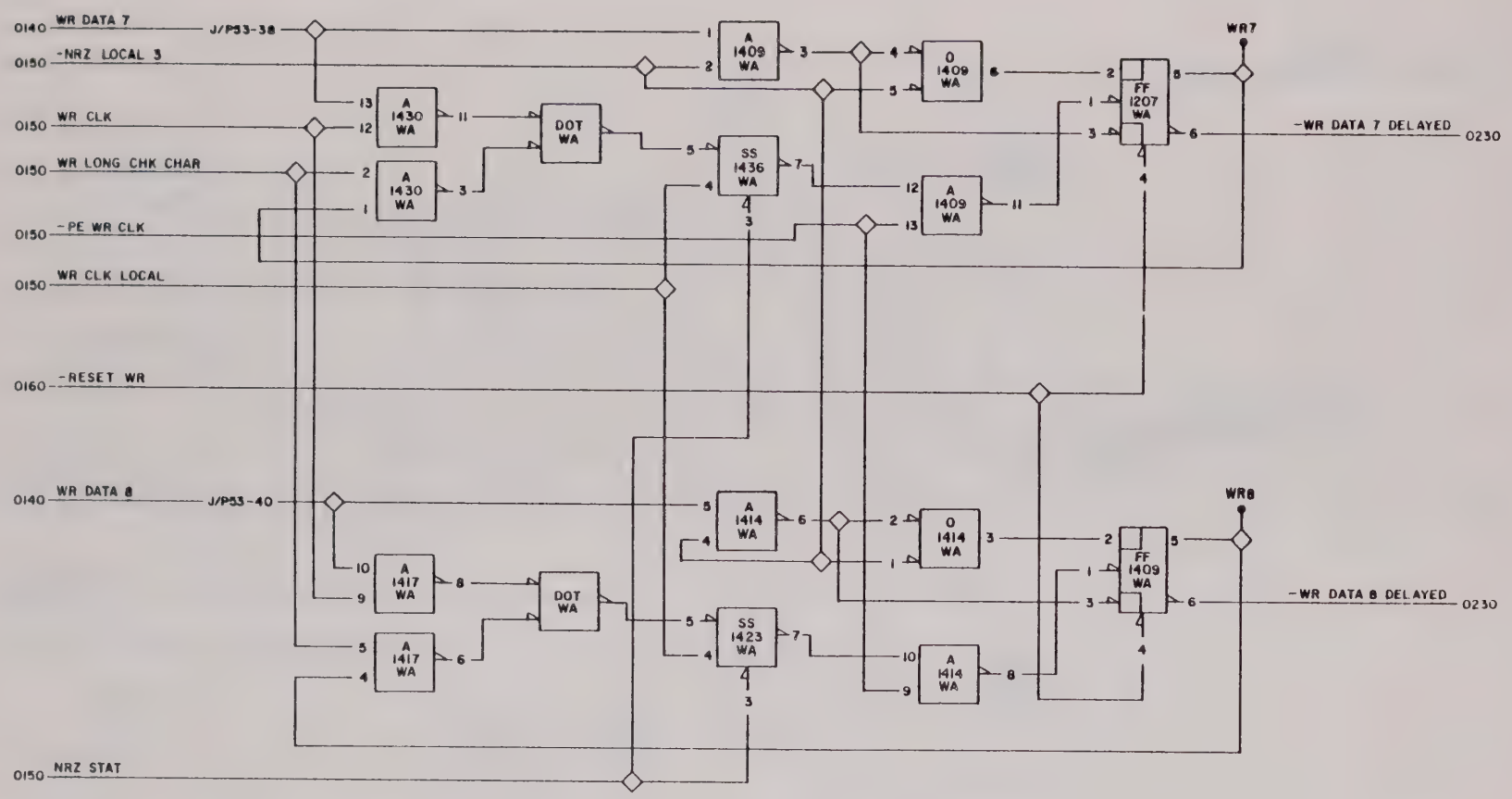


WRITE CIRCUITS 3 AND 4
0190

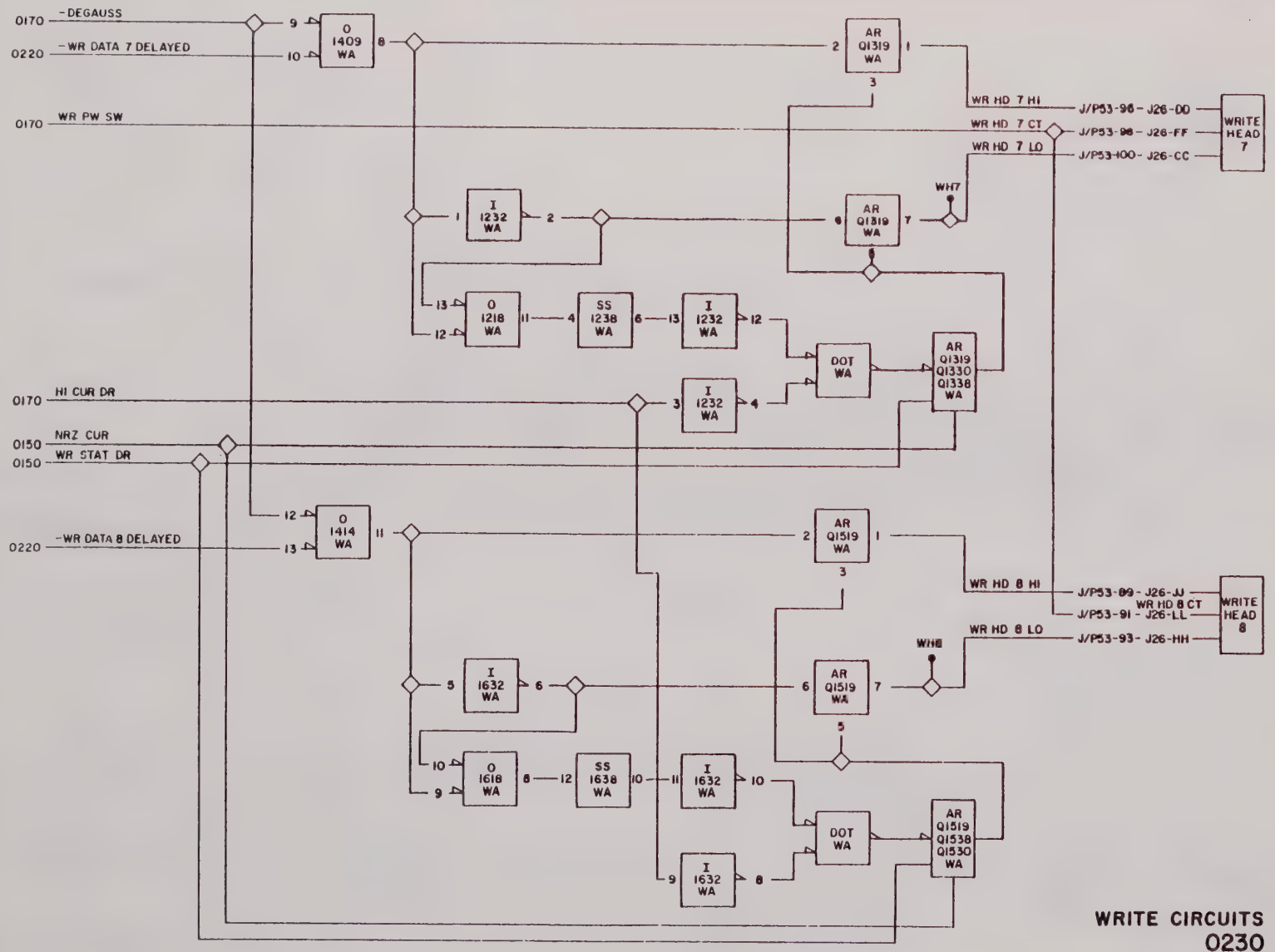


WRITE CIRCUITS 5 & 6
0200

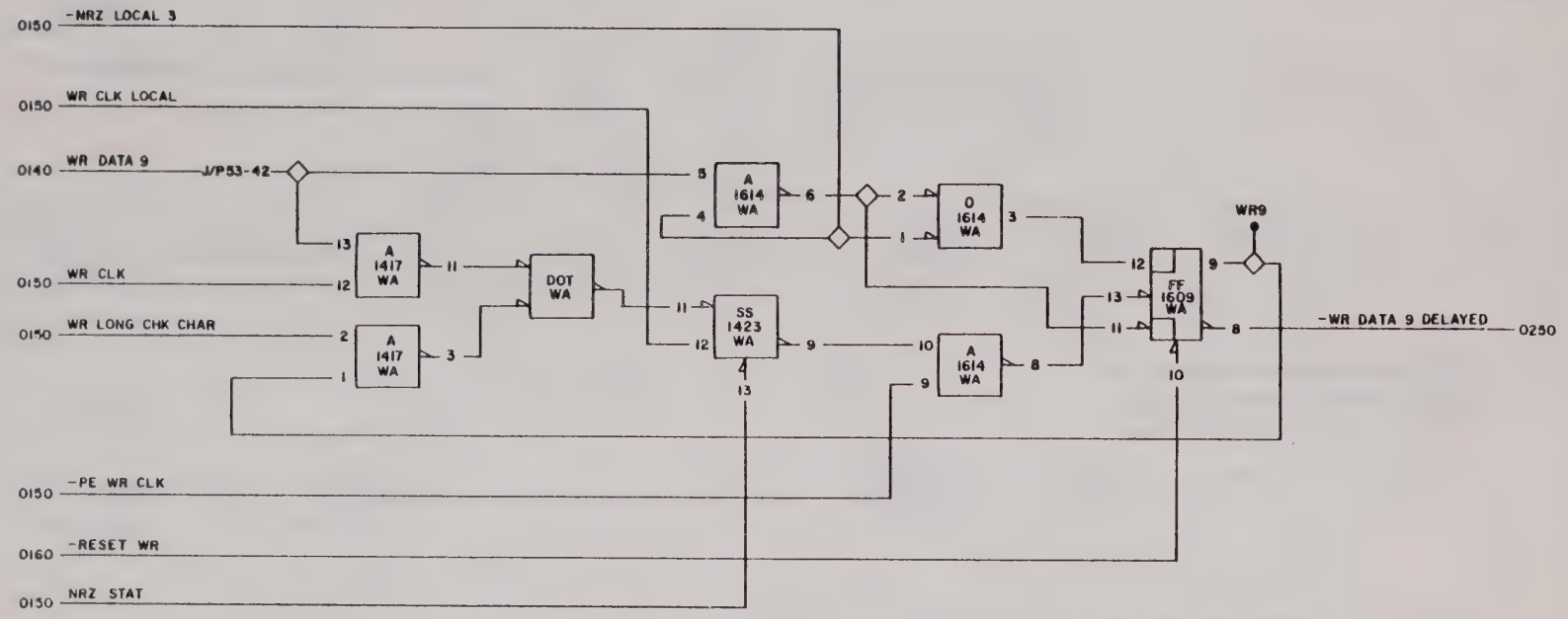

0170 -DEGAUSS
0200 -WR DATA 5 DELAYED
0170 WR PW SW
0170 HI CUR DR
0150 NRZ CUR
0150 WR STAT DR
0200 -WR DATA 6 DELAYED
0 914 WA
I 932 WA
0 918 WA
SS 938 WA
I 932 WA
AR Q1019 WA
DOT WA
AR Q1019 Q1030 Q1038 WA
I 932 WA
WH5
WR HD 5 HI
WR HD 5 CT
WR HD 5 LO
J/P53-84 — J26-V
J/P53-86 — J26-X
J/P53-88 — J26-U
WRITE HEAD 5
0 1214 WA
I 1232 WA
0 1218 WA
SS 1238 WA
I 1232 WA
AR Q1119 WA
DOT WA
AR Q1119 Q1130 Q1138 WA
I 1232 WA
WH6
WR HD 6 HI
WR HD 6 CT
WR HD 6 LO
J/P53-90 — J26-Z
J/P53-92 — J26-BB
J/P53-94 — J26-Y
WRITE HEAD 6
WRITE CIRCUITS 5 & 6
0210



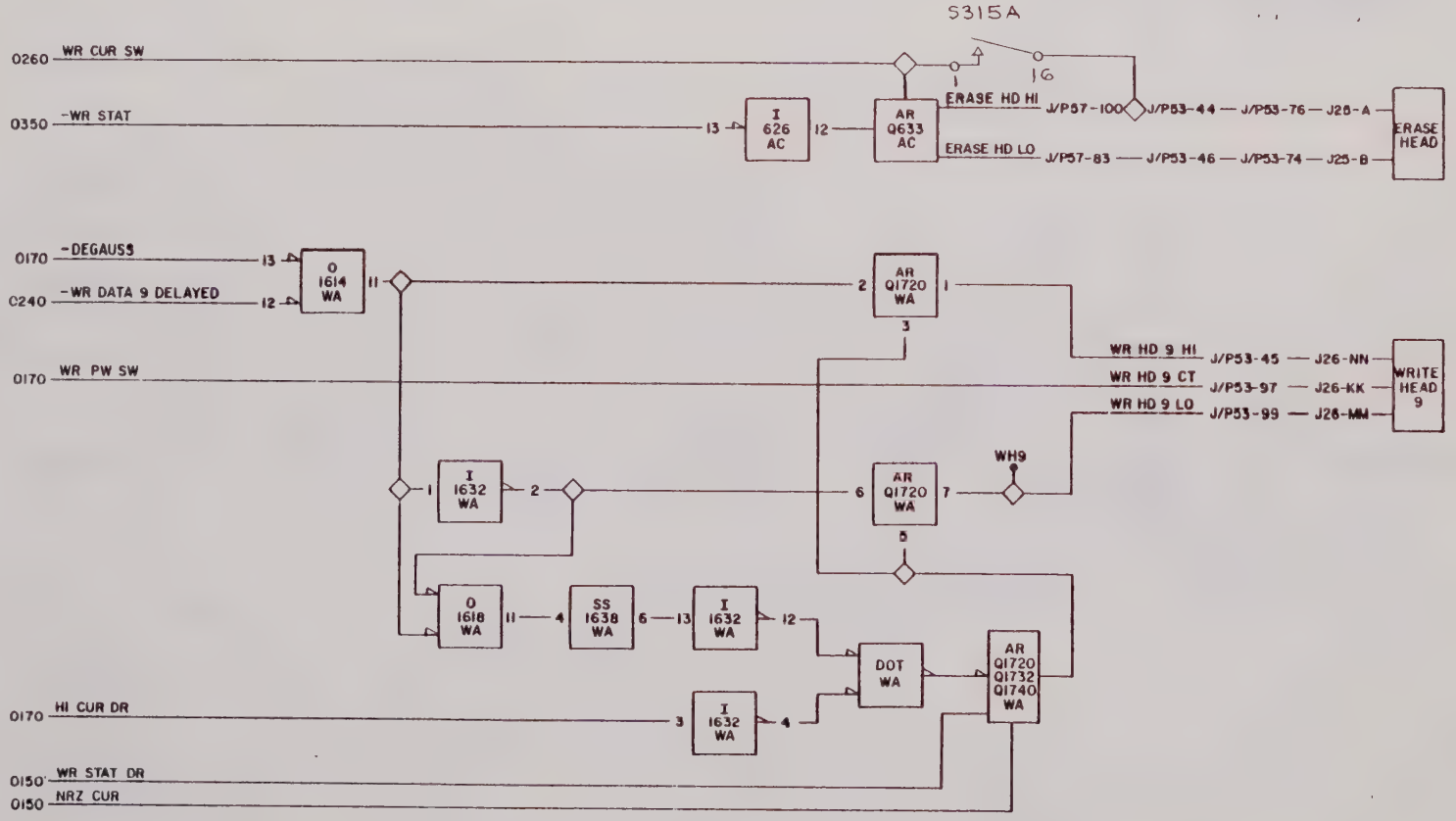
WRITE CIRCUITS 7 AND 8
0220



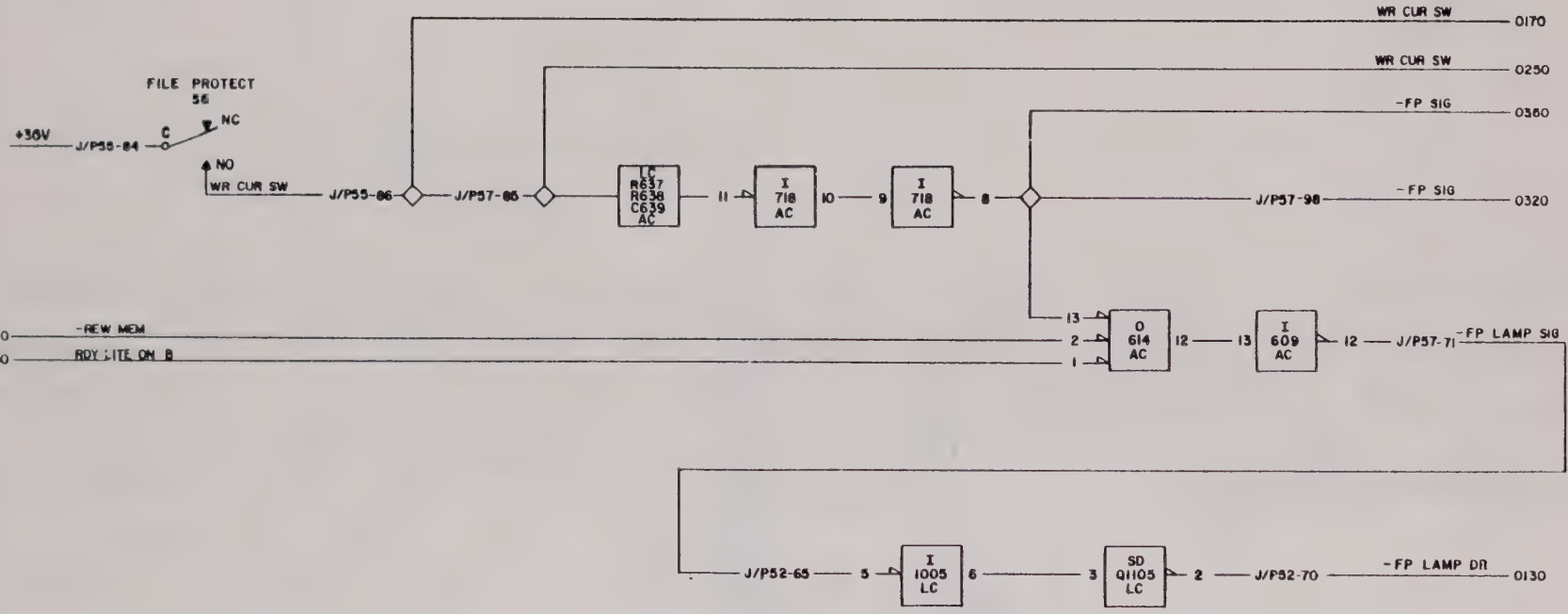
WRITE CIRCUITS 7 AND 8
0230



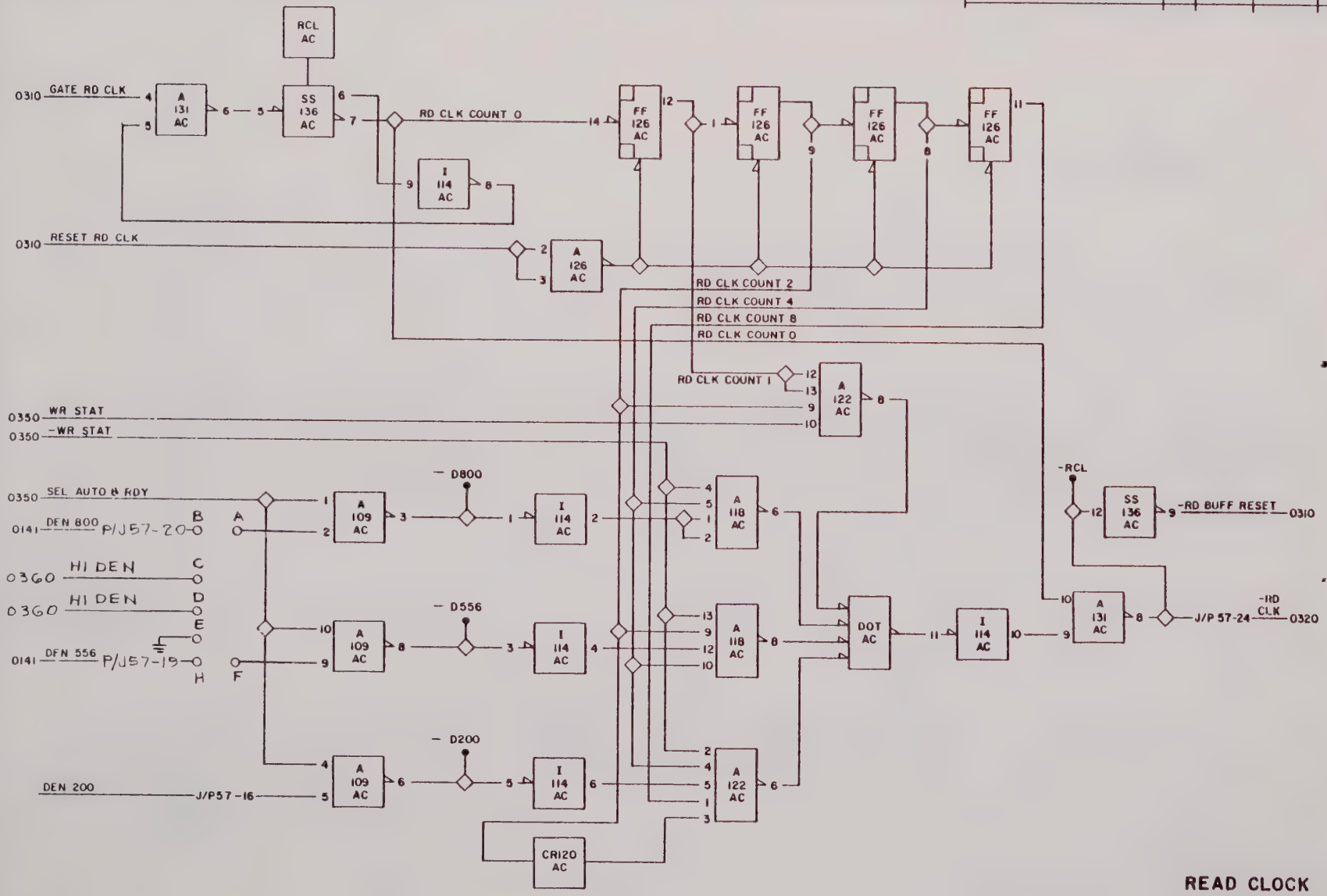
WRITE CIRCUIT 9
0240

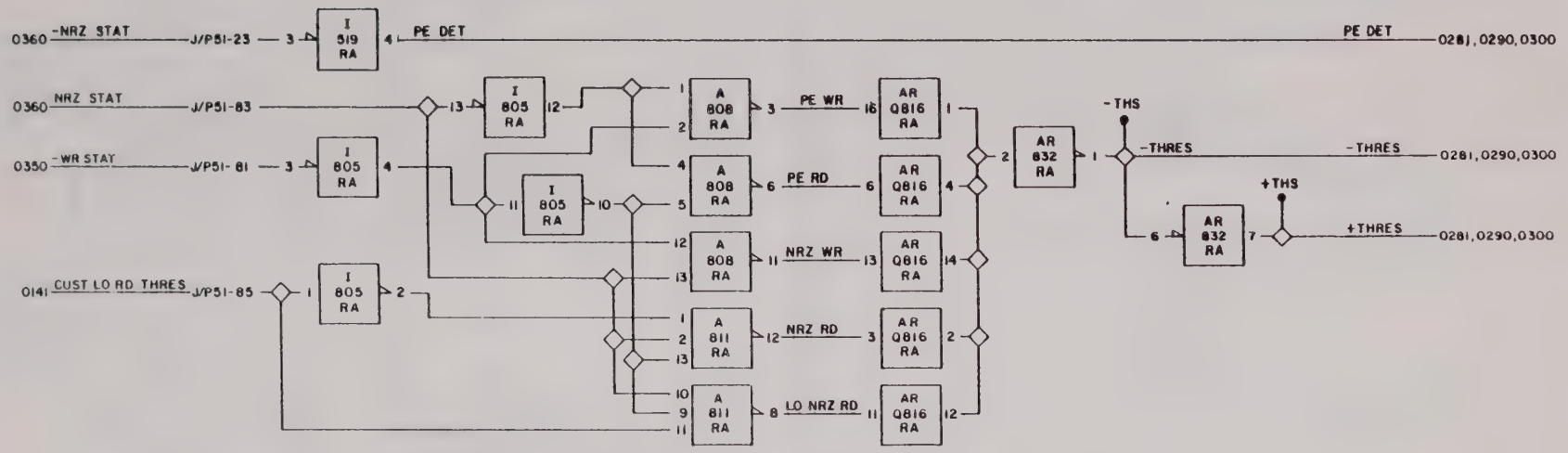


WRITE CIRCUIT 9 AND ERASE CIRCUIT
0250

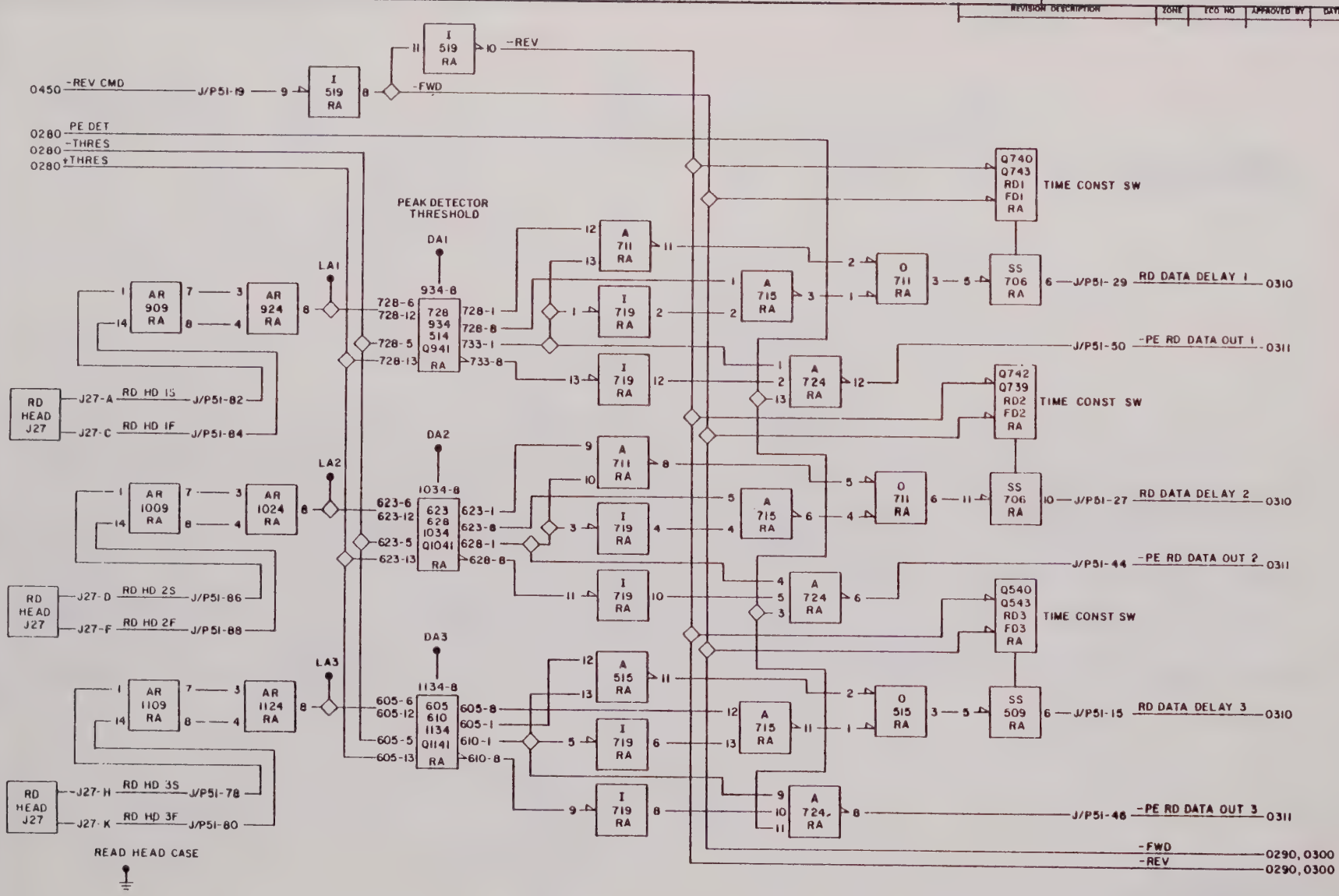


FILE PROTECT
0260

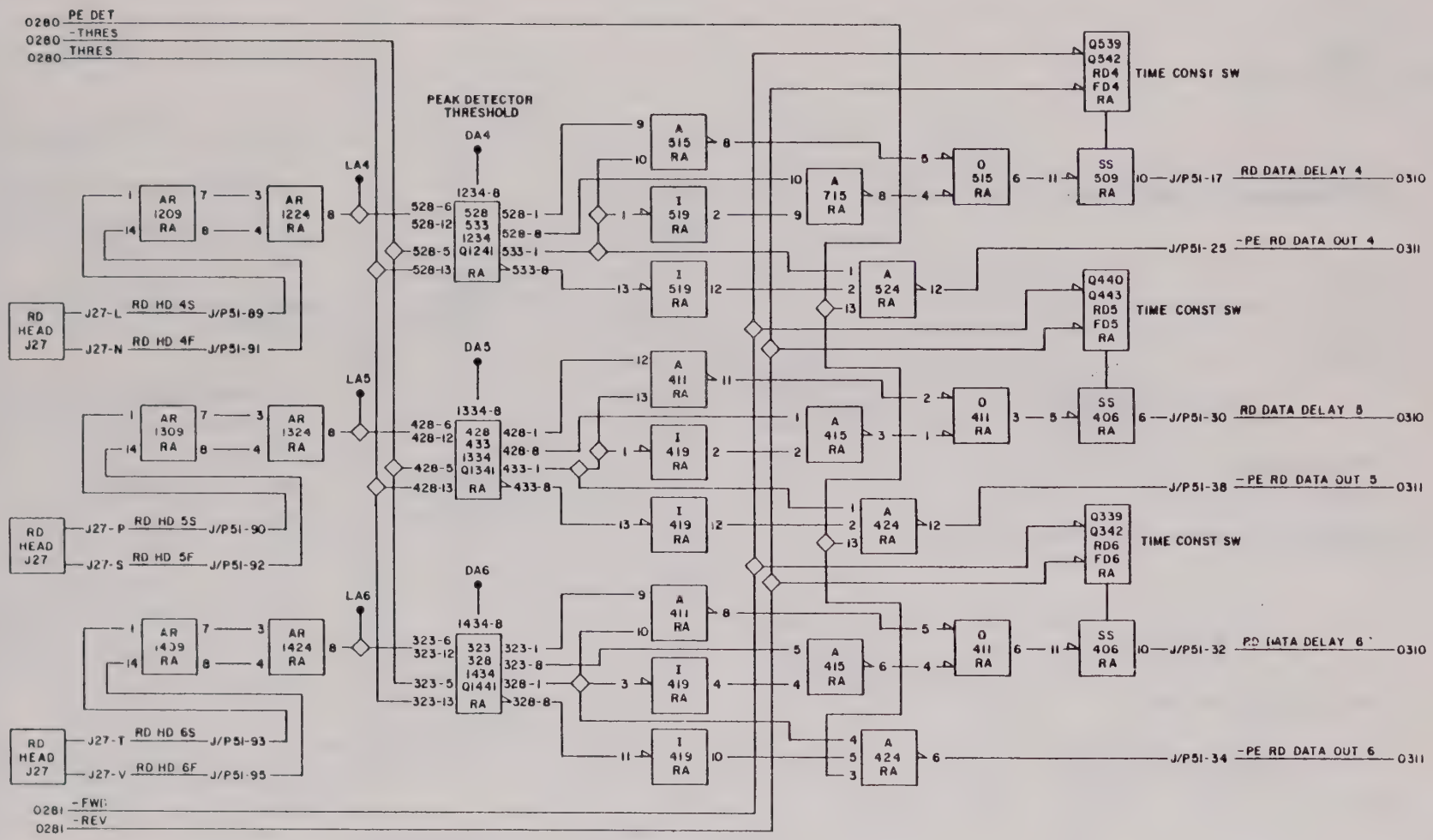

REVISION DESCRIPTION
ZONE
ECO NO
APPROVED BY
DATE
RCL AC
0310 GATE RD CLK
A 131 AC
SS 136 AC
RD CLK COUNT 0
I 114 AC
FF 126 AC
FF 126 AC
FF 126 AC
FF 126 AC
0310 RESET RD CLK
A 126 AC
RD CLK COUNT 2
RD CLK COUNT 4
RD CLK COUNT 8
RD CLK COUNT 0
RD CLK COUNT 1
A 122 AC
0350 WR STAT
0350 -WR STAT
0350 SEL AUTO & RDY
0141 DEN 800 P/J57-20
0360 HI DEN
0360 HI DEN
0141 DEN 556 P/J57-19
DEN 200 J/P57-16
A 109 AC
A 109 AC
A 109 AC
- D800
- D556
- D200
I 114 AC
I 114 AC
I 114 AC
A 118 AC
A 118 AC
A 122 AC
DOT AC
I 114 AC
CR120 AC
-RCL
SS 136 AC
-RD BUFF RESET 0310
A 131 AC
J/P 57-24 -RD CLK 0320
C.P. SEL 556/200 A-E F-C
C.P. SEL 800/556 A-C F-D
C.P. SEL 800/200 A-C F-E
REMOTE SEL A-B F-H
DENSITY SEL JUMPERS
READ CLOCK
0270
2-64



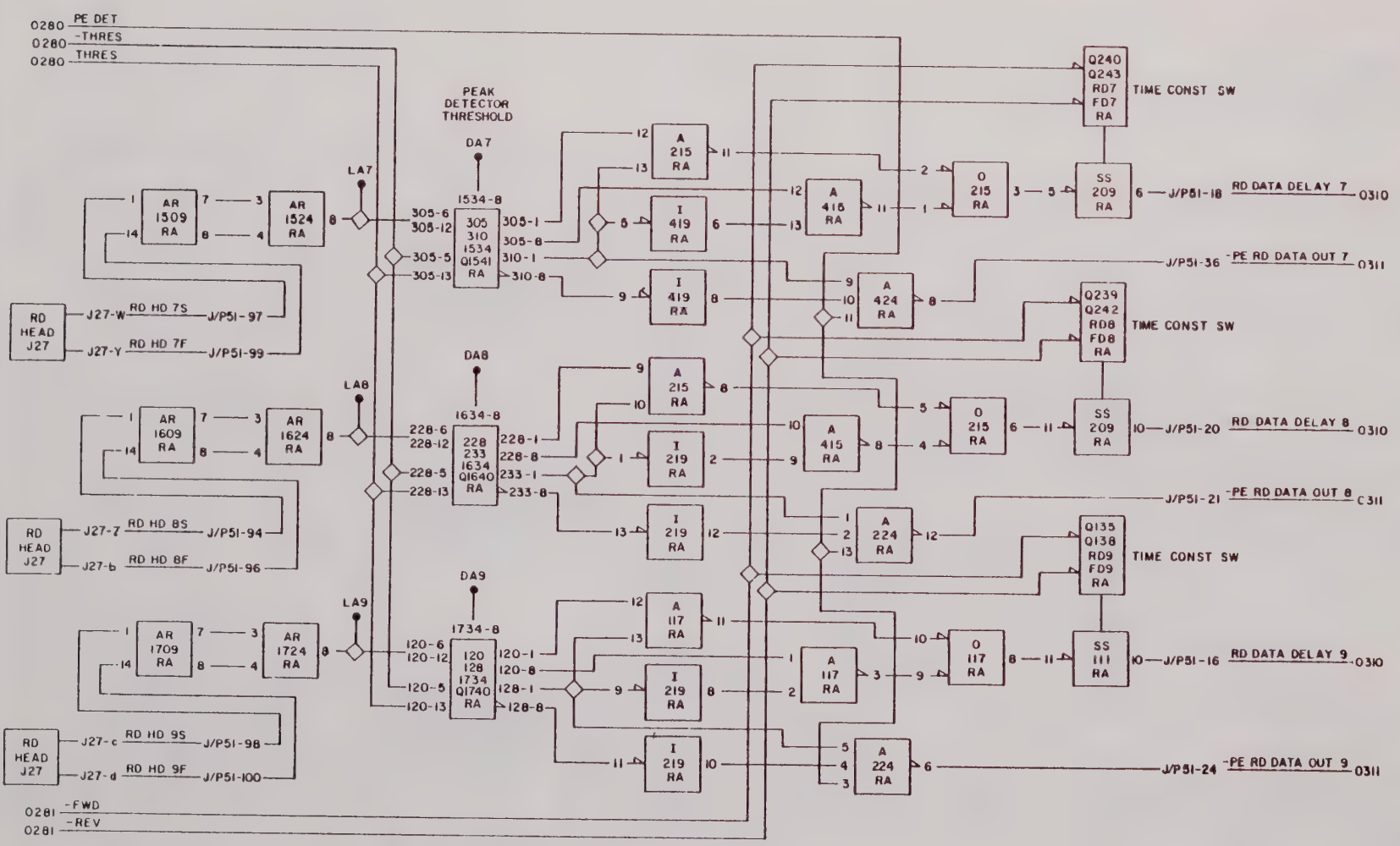
READ THRESHOLD
0280



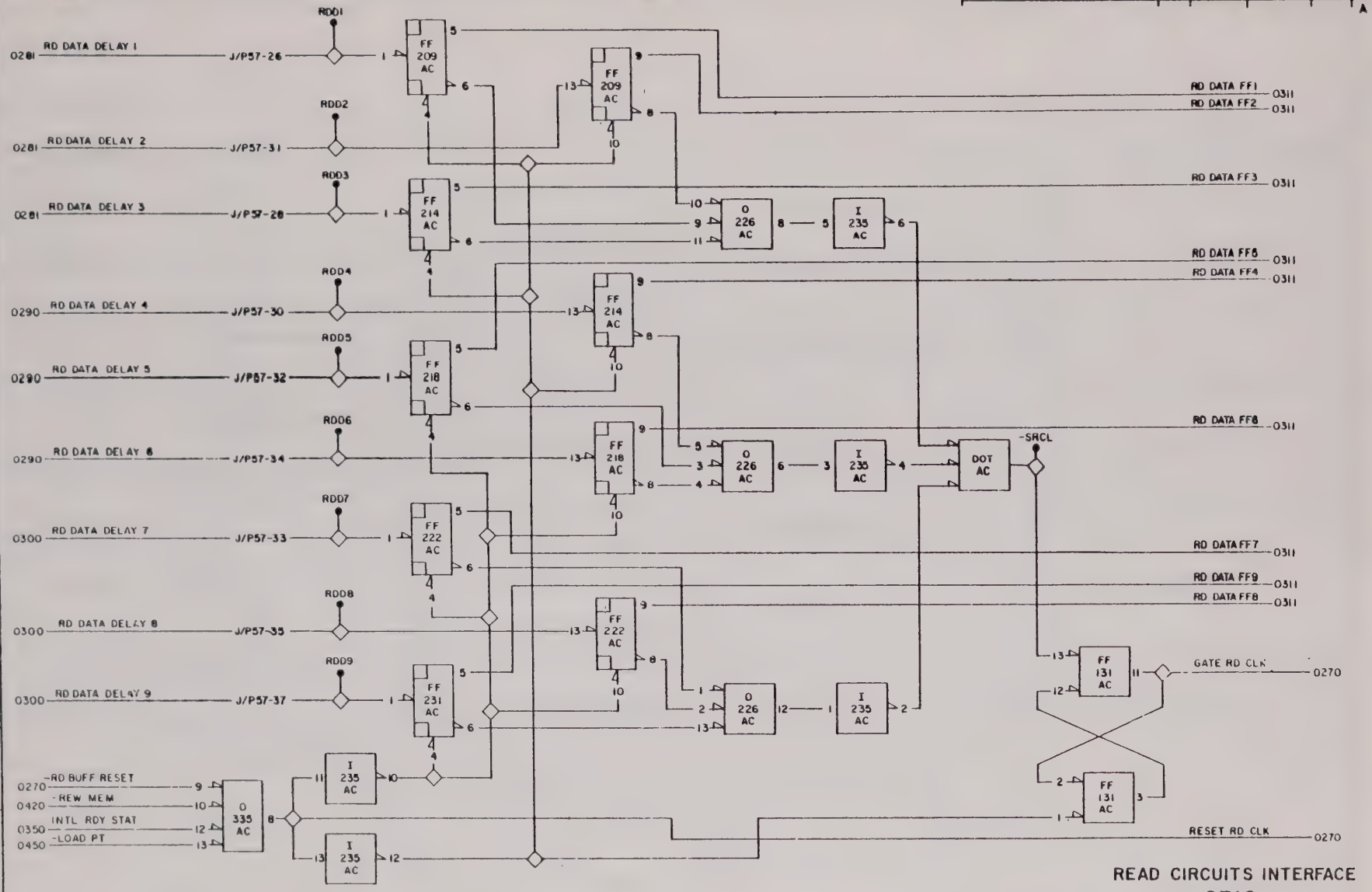
READ CIRCUIT 1, 2, & 3
0281



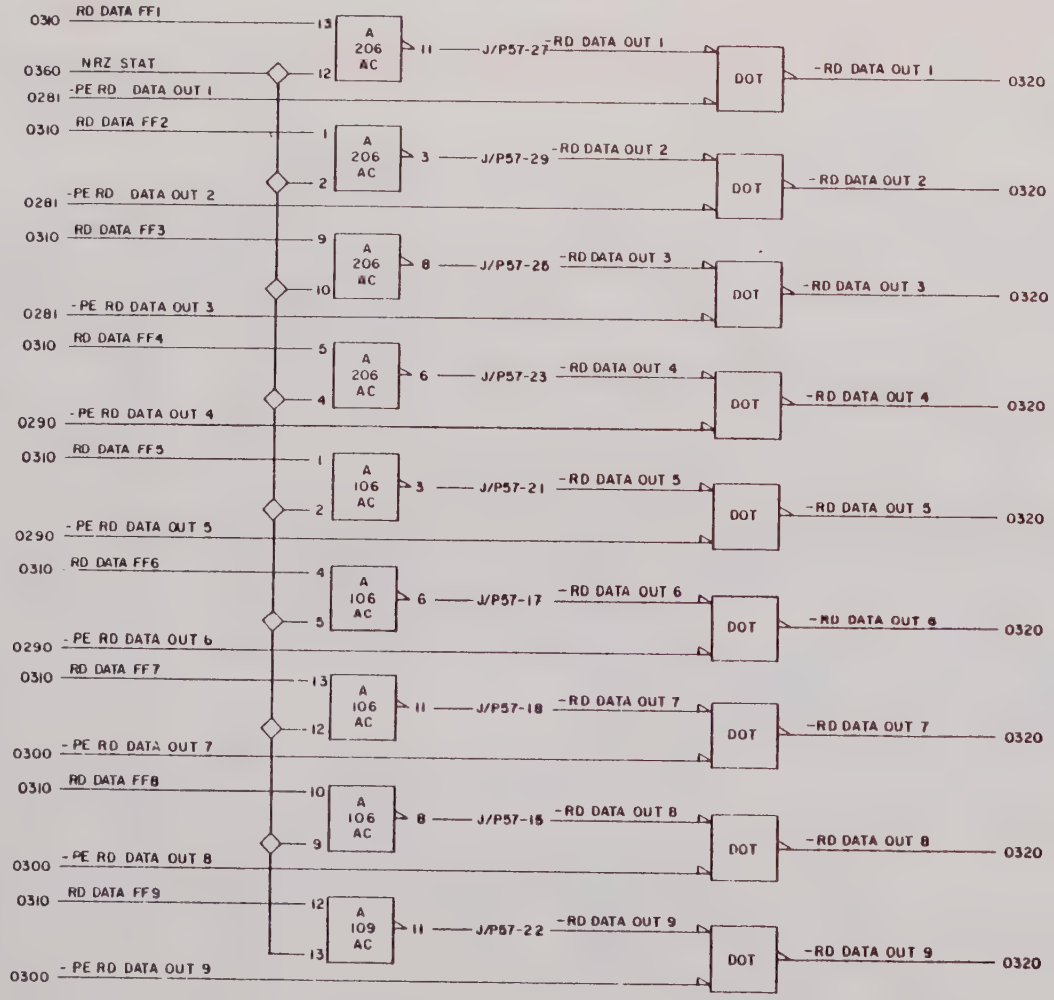
READ CIRCUIT 4, 5, & 6
0290



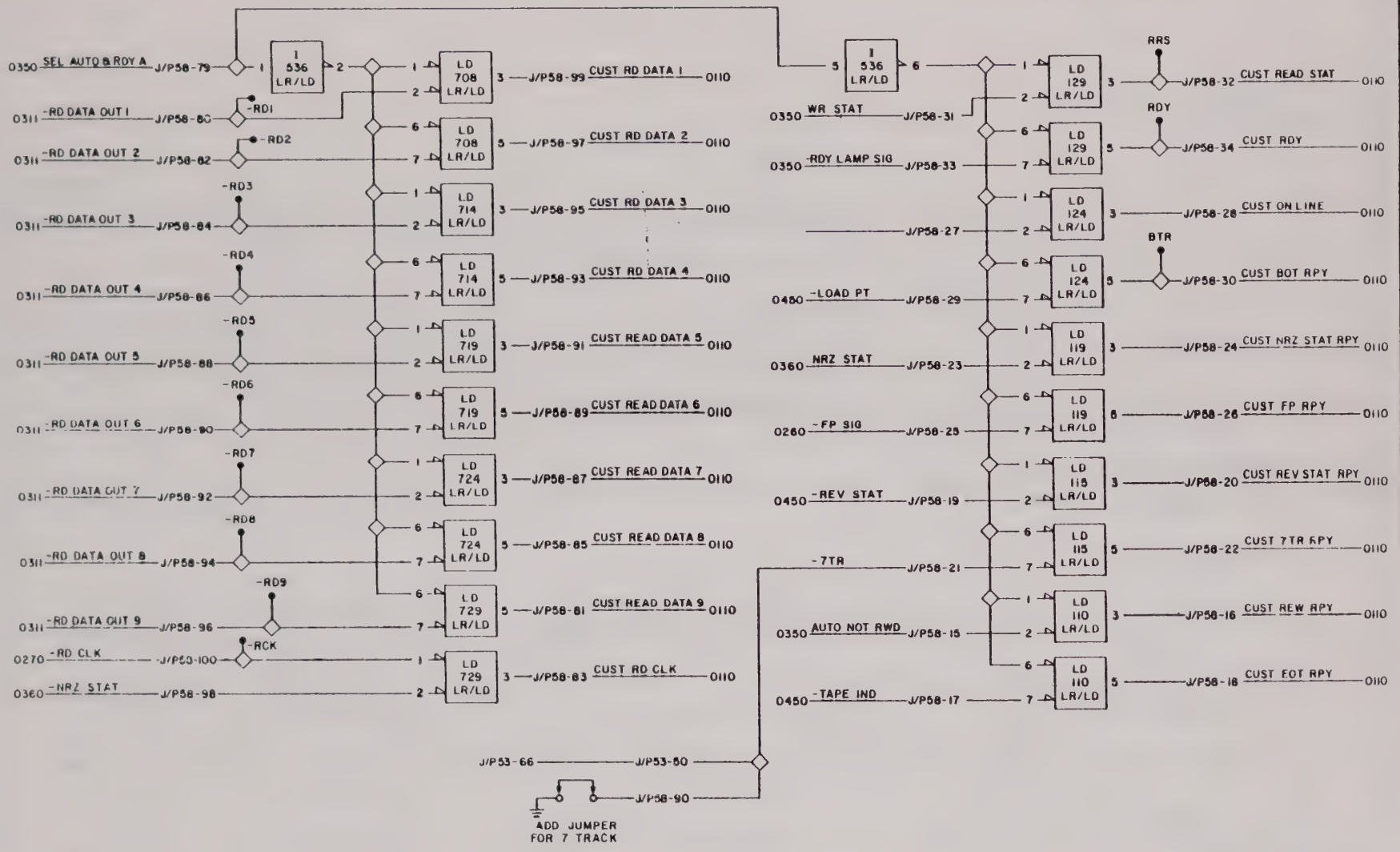
READ CIRCUIT 7, 8, & 9
0300



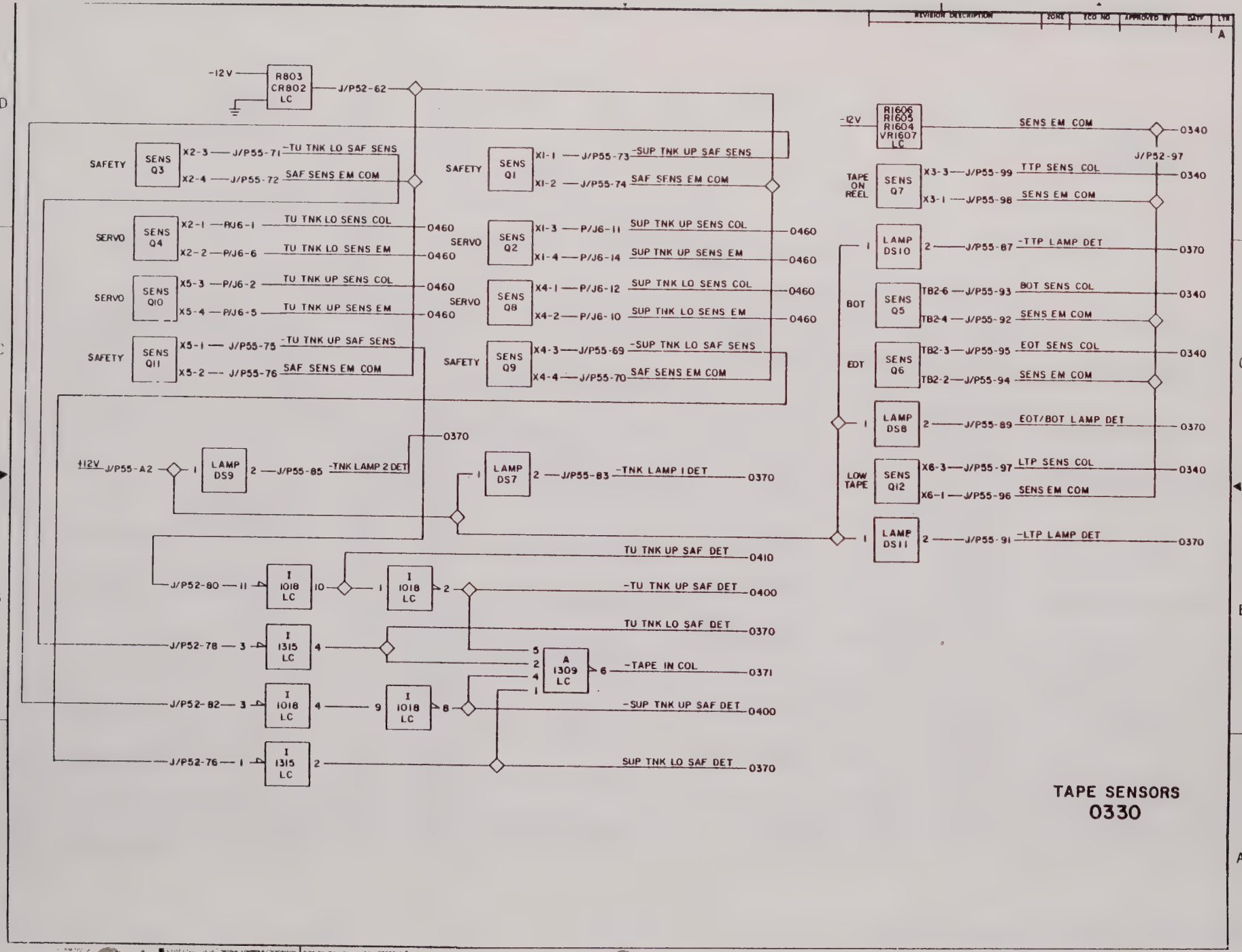
READ CIRCUITS INTERFACE
0310

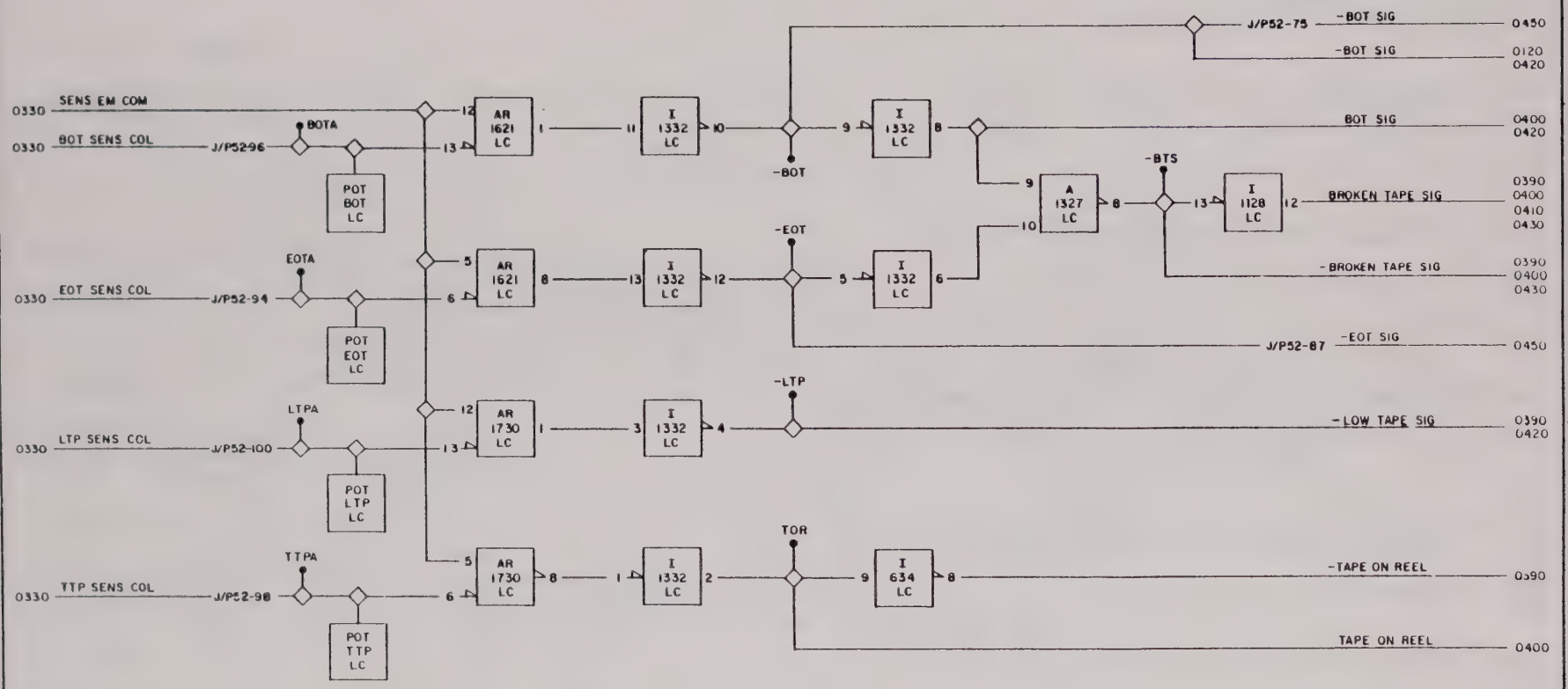


READ CIRCUITS INTERFACE
0311



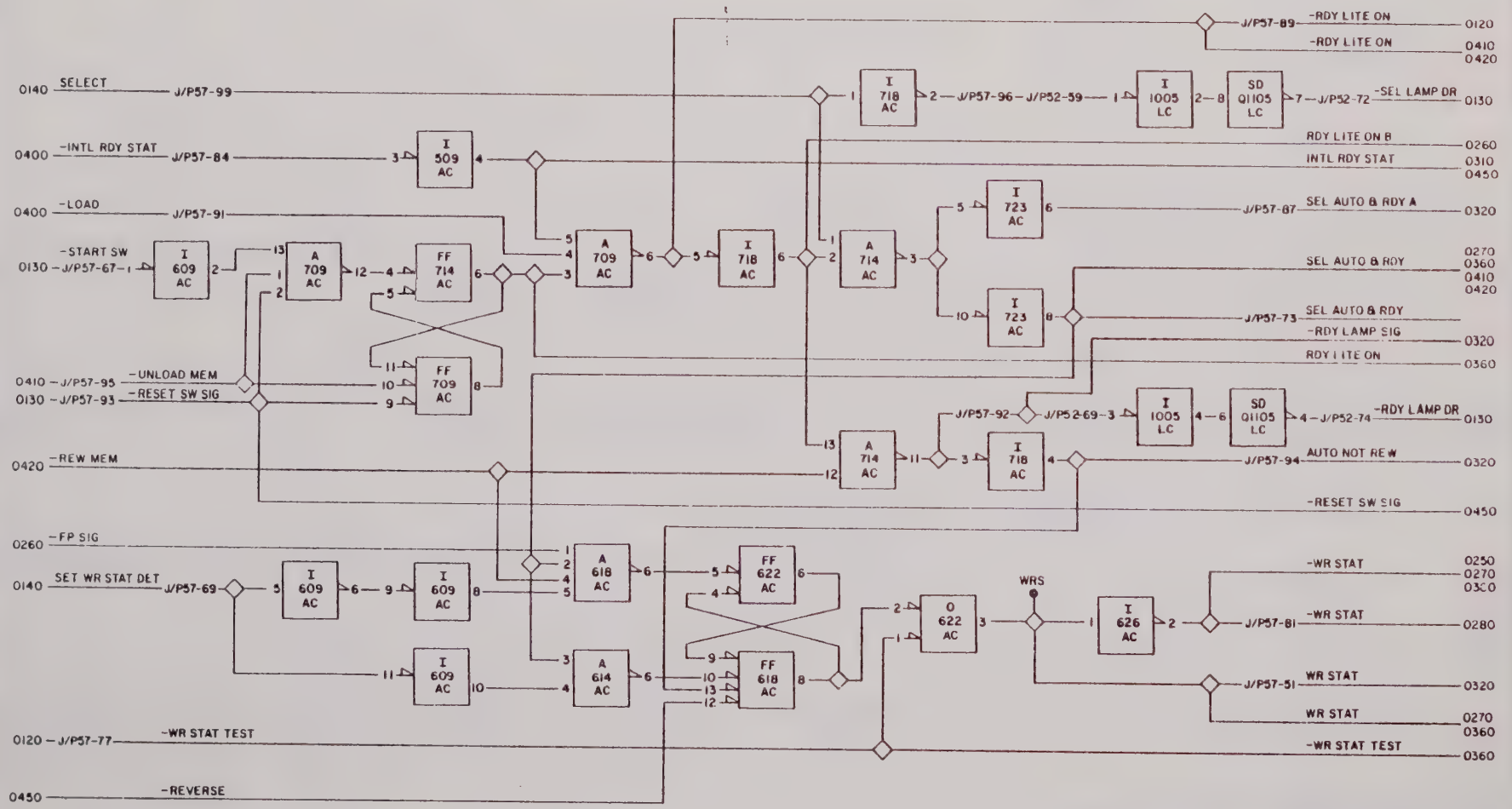
LINE DRIVERS
0320


REVISION DESCRIPTION
ZONE
ECO NO
APPROVED BY
DATE
LTR
A
-12V
R803
CR802
LC
J/P52-62
SAFETY
SENS Q3
X2-3 — J/P55-71 -TU TNK LO SAF SENS
X2-4 — J/P55-72 SAF SENS EM COM
SAFETY
SENS Q1
X1-1 — J/P55-73 -SUP TNK UP SAF SENS
X1-2 — J/P55-74 SAF SENS EM COM
SERVO
SENS Q4
X2-1 — PJ6-1 TU TNK LO SENS COL 0460
X2-2 — PJ6-6 TU TNK LO SENS EM 0460
SERVO
SENS Q2
X1-3 — P/J6-11 SUP TNK UP SENS COL 0460
X1-4 — P/J6-14 SUP TNK UP SENS EM 0460
SERVO
SENS Q10
X5-3 — P/J6-2 TU TNK UP SENS COL 0460
X5-4 — P/J6-5 TU TNK UP SENS EM 0460
SERVO
SENS Q8
X4-1 — P/J6-12 SUP TNK LO SENS COL 0460
X4-2 — P/J6-10 SUP TNK LO SENS EM 0460
SAFETY
SENS Q11
X5-1 — J/P55-75 -TU TNK UP SAF SENS
X5-2 — J/P55-76 SAF SENS EM COM
SAFETY
SENS Q9
X4-3 — J/P55-69 -SUP TNK LO SAF SENS
X4-4 — J/P55-70 SAF SENS EM COM
0370
+12V J/P55-A2
LAMP DS9
2 — J/P55-85 -TNK LAMP 2 DET
LAMP DS7
2 — J/P55-83 -TNK LAMP 1 DET 0370
TU TNK UP SAF DET 0410
J/P52-80 — 11
I 1018 LC
10
I 1018 LC
2
-TU TNK UP SAF DET 0400
TU TNK LO SAF DET 0370
J/P52-78 — 3
I 1315 LC
4
5
2
A 1309 LC
6
-TAPE IN COL 0371
J/P52-82 — 3
I 1018 LC
4
9
I 1018 LC
8
4
1
-SUP TNK UP SAF DET 0400
J/P52-76 — 1
I 1315 LC
2
SUP TNK LO SAF DET 0370
-12V
R1606
R1605
R1604
VR1607
LC
SENS EM COM 0340
J/P52-97
TAPE ON REEL
SENS Q7
X3-3 — J/P55-99 TTP SENS COL 0340
X3-1 — J/P55-98 SENS EM COM
LAMP DS10
2 — J/P55-87 -TTP LAMP DET 0370
BOT
SENS Q5
TB2-6 — J/P55-93 BOT SENS COL 0340
TB2-4 — J/P55-92 SENS EM COM
EOT
SENS Q6
TB2-3 — J/P55-95 EOT SENS COL 0340
TB2-2 — J/P55-94 SENS EM COM
LAMP DS8
2 — J/P55-89 EOT/BOT LAMP DET 0370
LOW TAPE
SENS Q12
X6-3 — J/P55-97 LTP SENS COL 0340
X6-1 — J/P55-96 SENS EM COM
LAMP DS11
2 — J/P55-91 -LTP LAMP DET 0370
TAPE SENSORS
0330
2-72

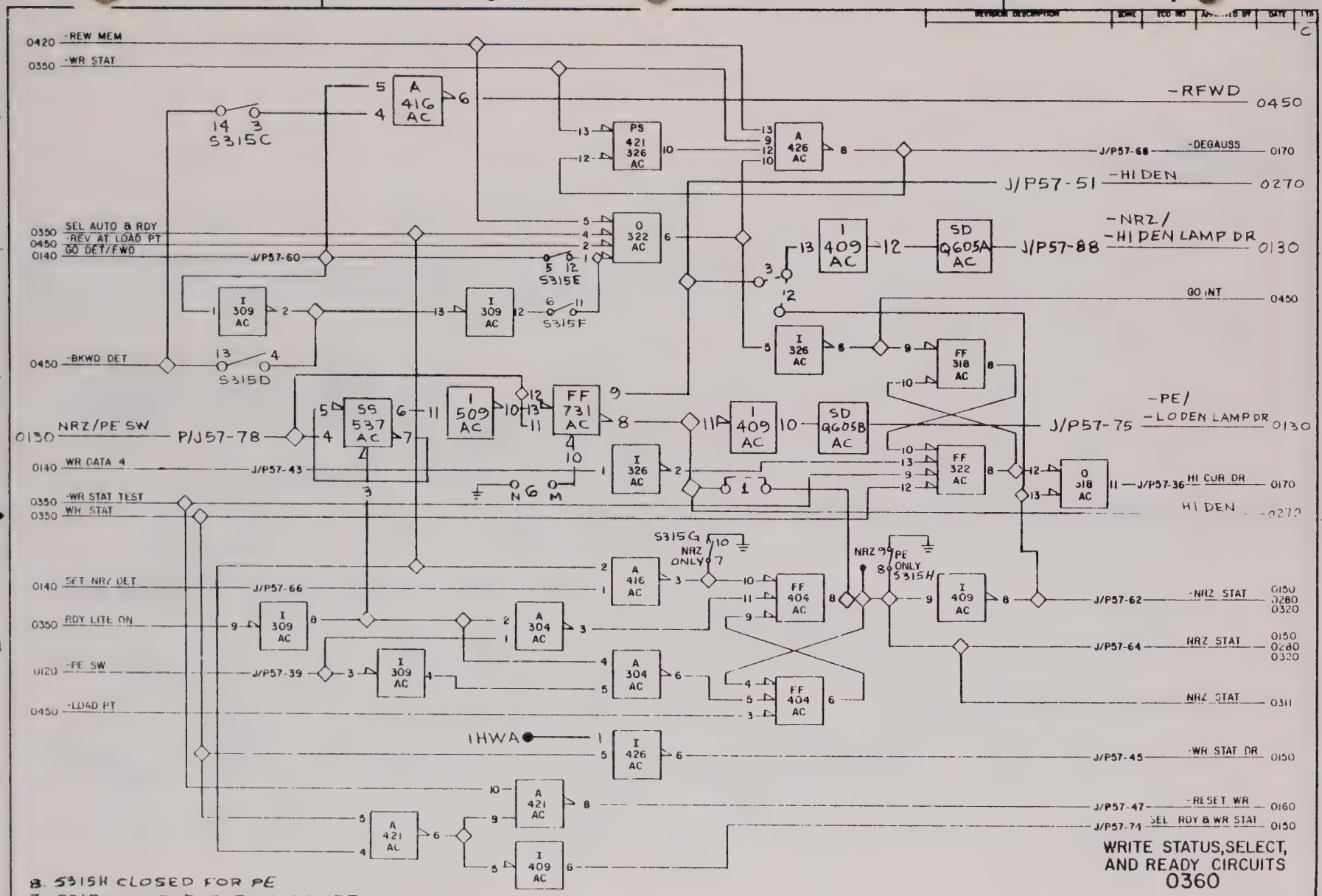


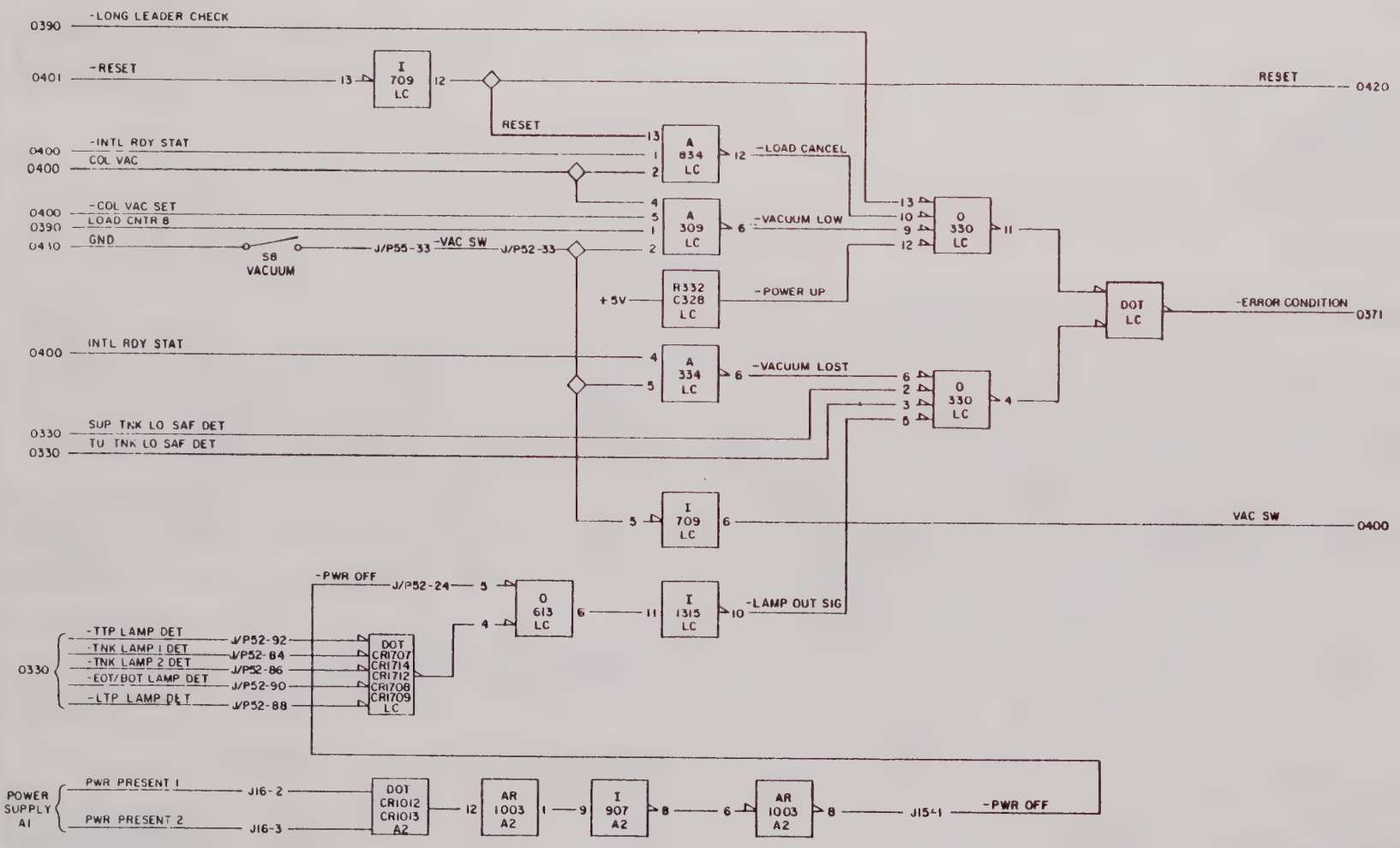
SENSOR AMPLIFIER
0340

REVISION DESCRIPTION	ZONE	ECO NO	APPROVED BY	DATE	LTR
					A

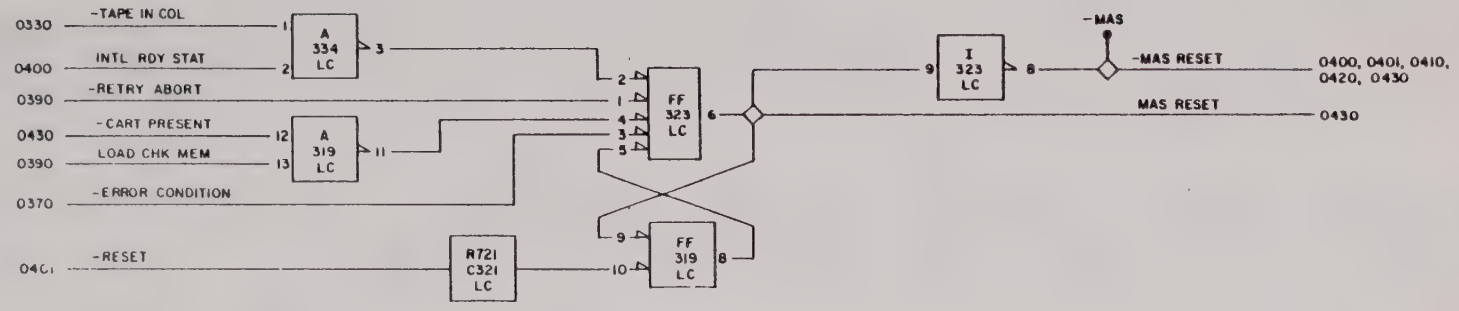


WRITE STATUS, SELECT, & READY CIRCUITS
0350

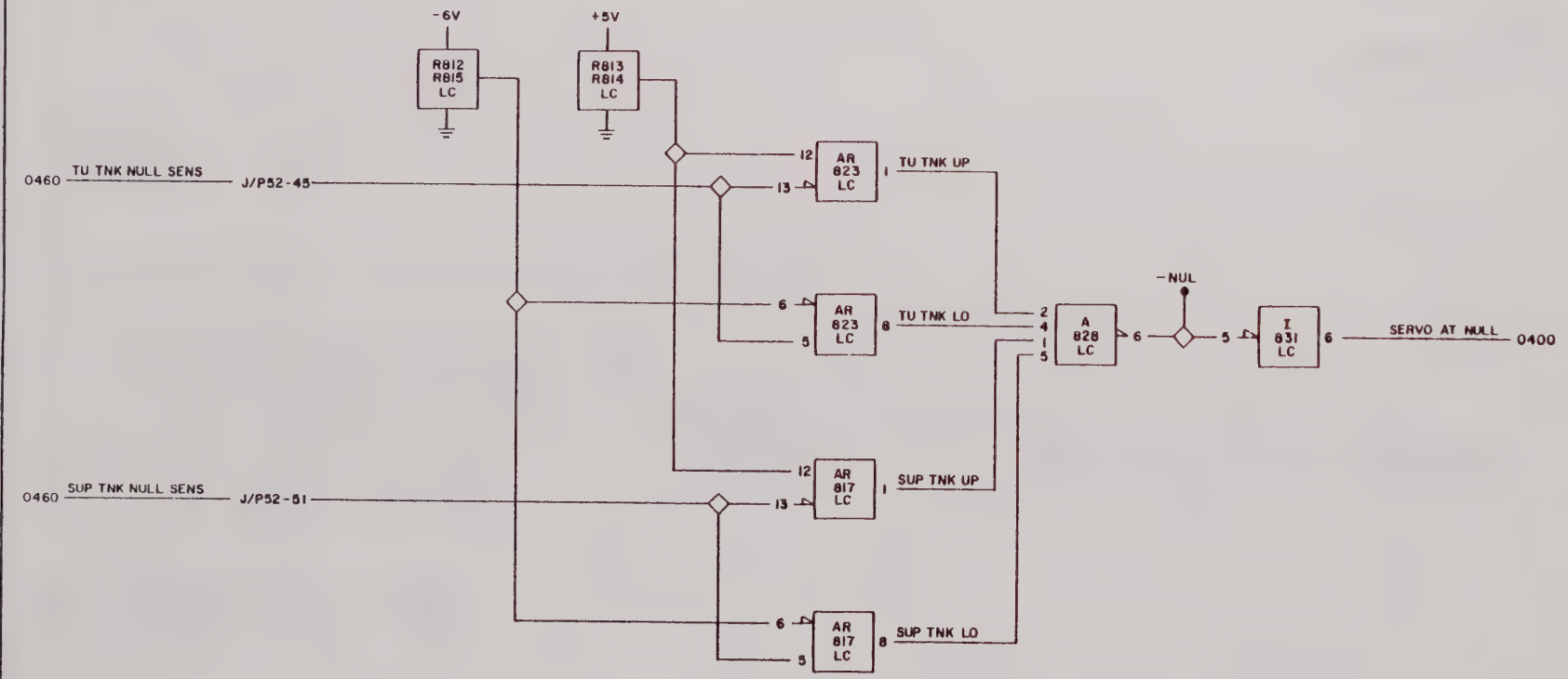

0420 -REW MEM
0350 -WR STAT
-RFWD 0450
S315C
-DEGAUSS 0170
J/P57-51 -HI DEN 0270
0350 SEL AUTO & RDY
0450 -REV AT LOAD PT
0140 GO DET/FWD
J/P57-60
S315E
S315F
-NRZ/
-HI DEN LAMP DR 0130
GO INT 0450
0450 -BKWD DET
S315D
0130 NRZ/PE SW
P/J57-78
-PE/
-LO DEN LAMP DR 0130
J/P57-75
0140 WR DATA 4
J/P57-43
J/P57-36 HI CUR DR 0170
0350 -WR STAT TEST
0350 WR STAT
HI DEN 0270
S315G
NRZ ONLY
S315H
PE ONLY
0140 SET NRZ DET
J/P57-66
0350 RDY LITE ON
0120 -PE SW
J/P57-39
0450 -LOAD PT
J/P57-62 -NRZ STAT 0150 0280 0320
J/P57-64 NRZ STAT 0150 0280 0320
NRZ STAT 0311
THWA
J/P57-45 -WR STAT DR 0150
J/P57-47 -RESET WR 0160
J/P57-74 SEL RDY & WR STAT 0150
WRITE STATUS, SELECT, AND READY CIRCUITS
0360
8. S315H CLOSED FOR PE
7. S315G CLOSED FOR DD OR NRZ
6. M-N OPEN WHEN DENSITY SW IS ON CONTROL PANEL
5. S315F, S315D CLOSED FOR FWDC & REVC
4. S315E, S315C CLOSED FOR BKWD & GO
3. REQ'D FOR DD & NRZ
2. NOT REQ'D FOR DD & NRZ
1. NOT REQ'D FOR DD & NRZ
NOTE:



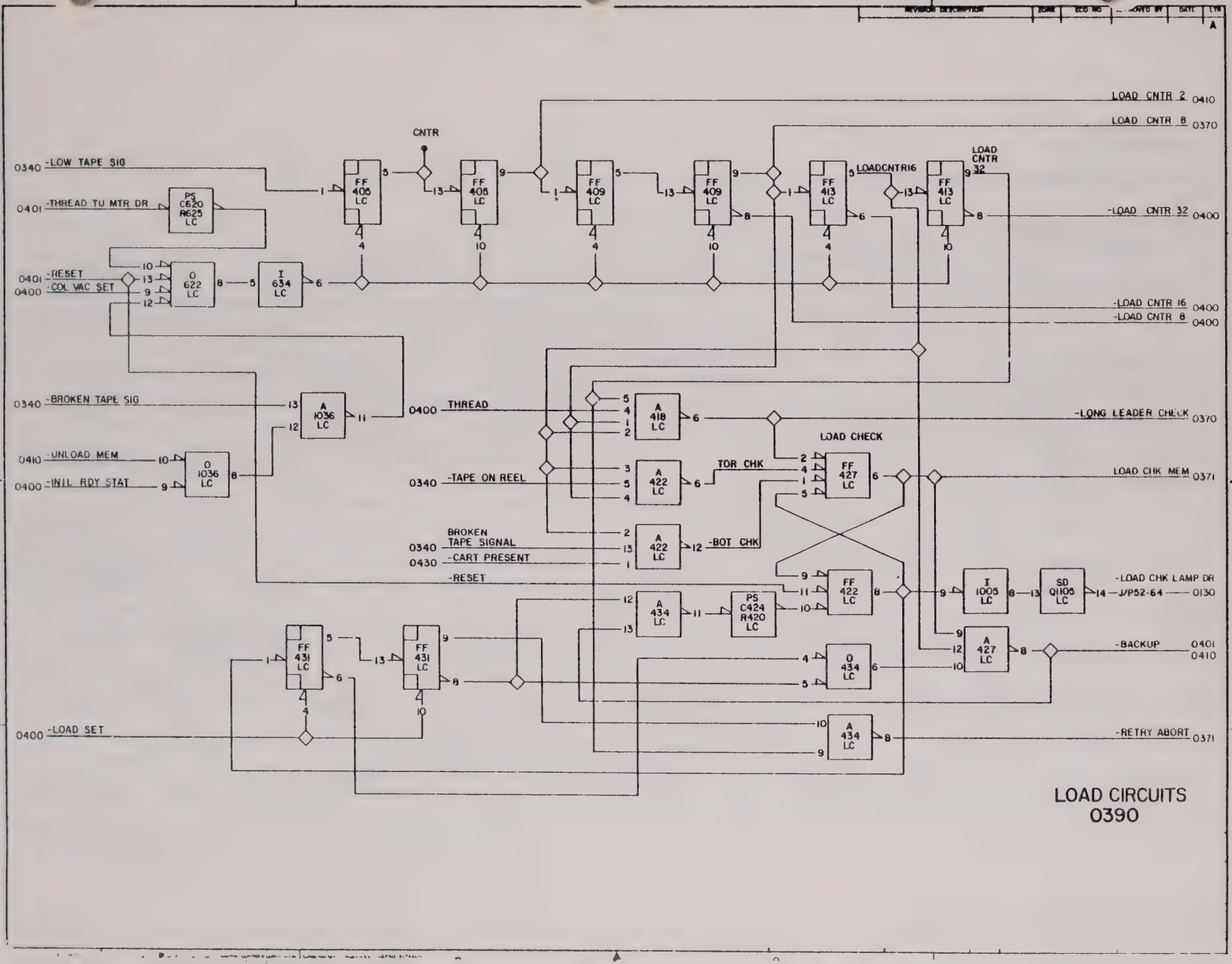
MASTER RESET CIRCUIT
0370

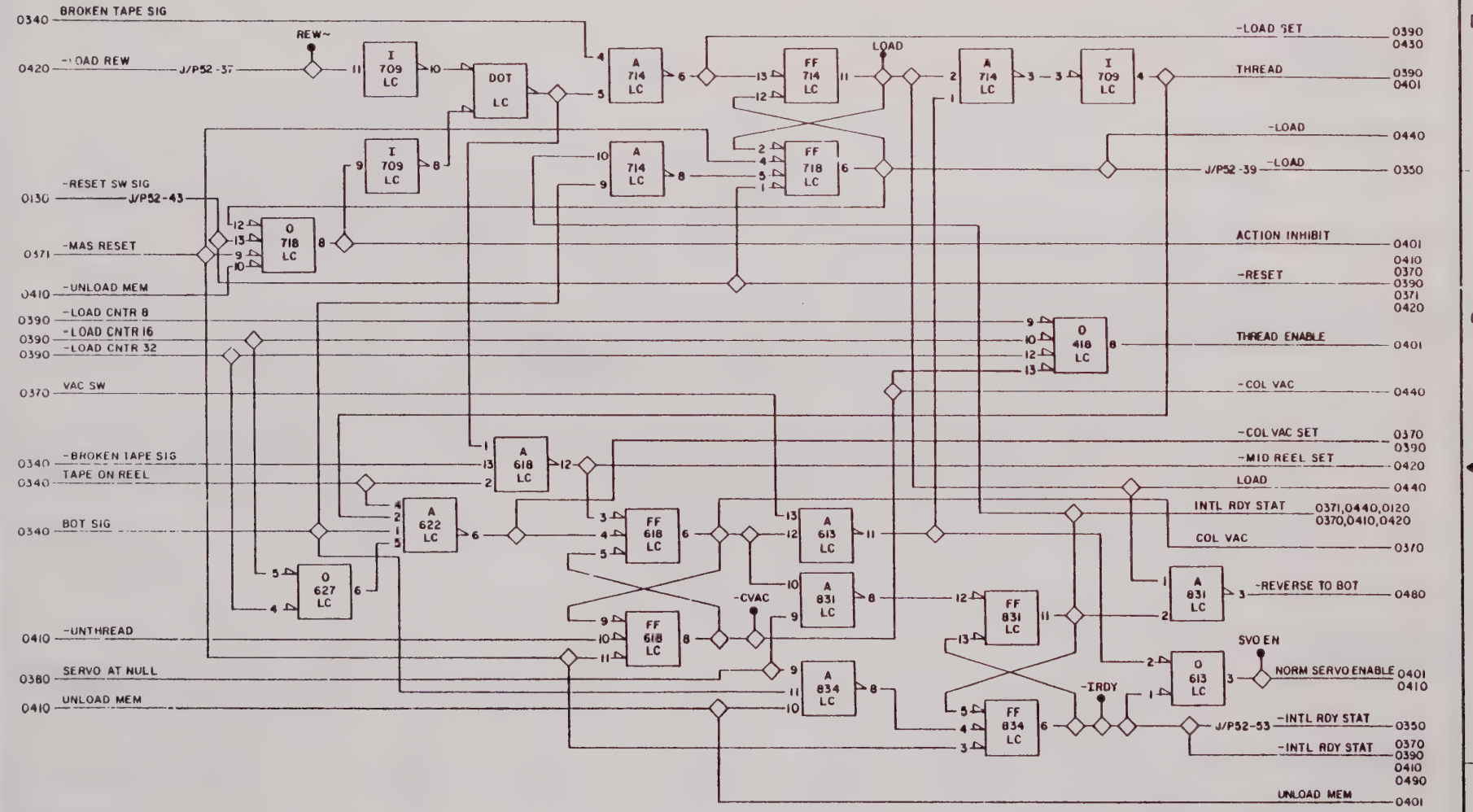


MASTER RESET CIRCUIT
0371

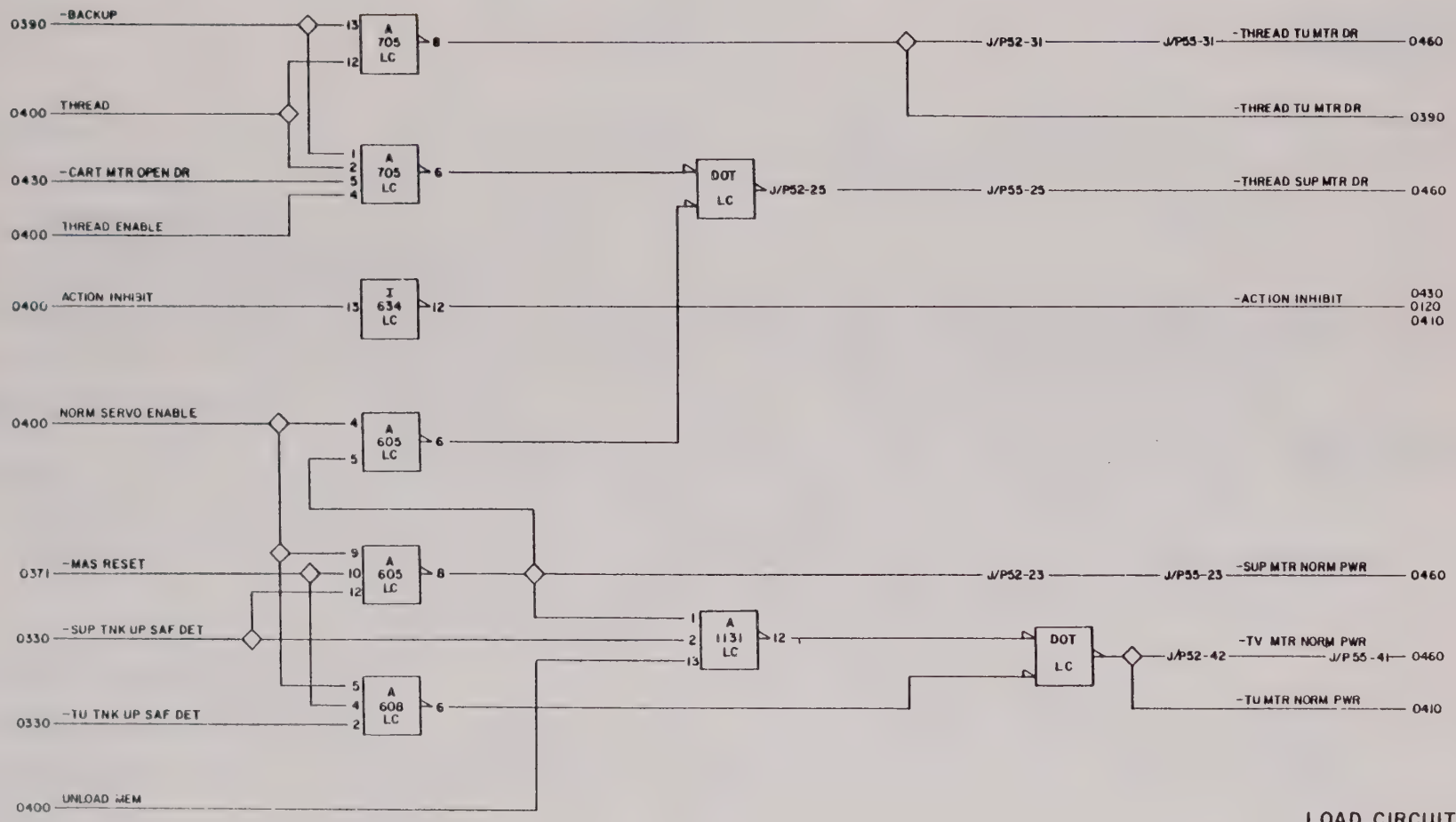


SERVO AT NULL CIRCUIT
0380

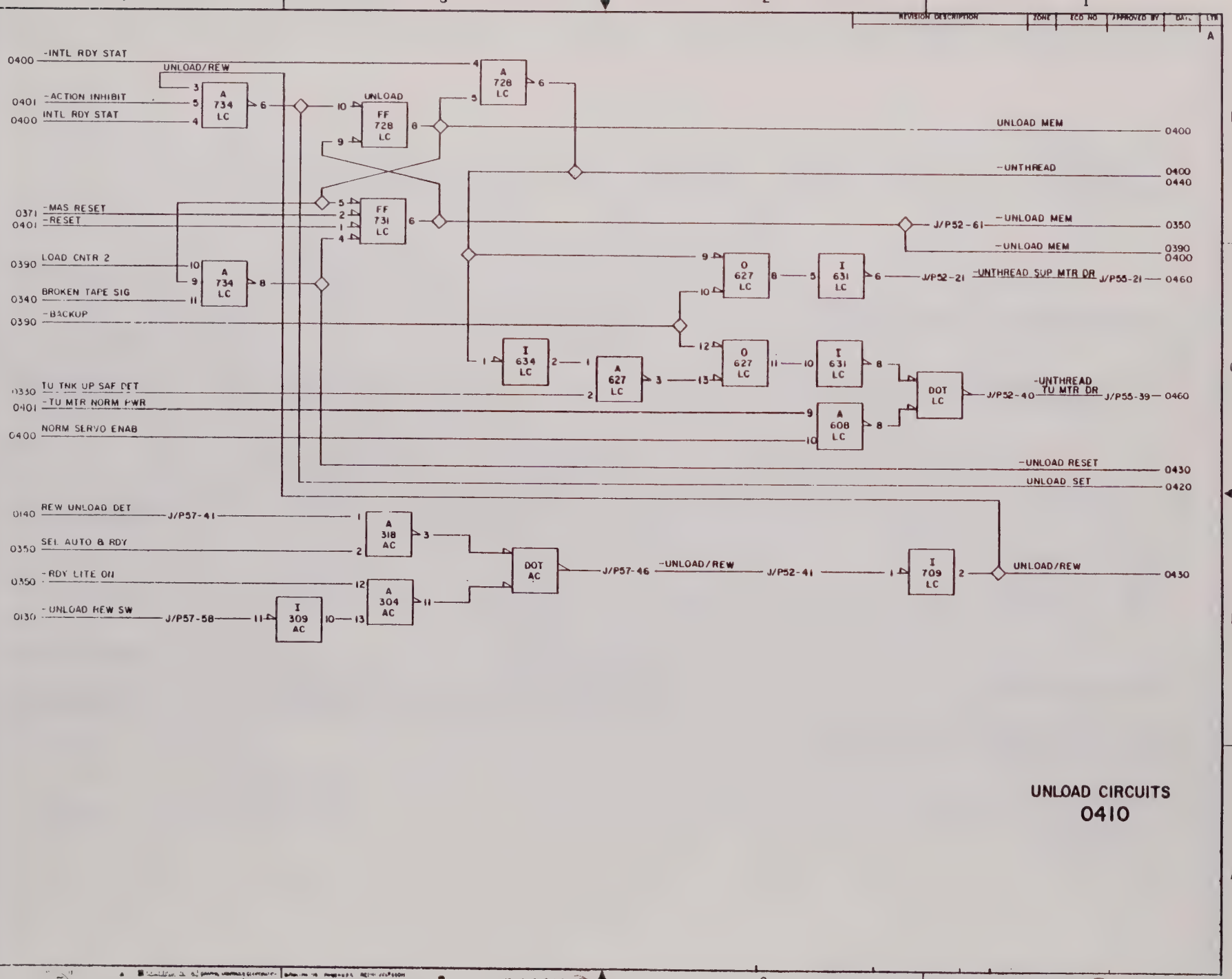

4
3
2
1
REVISION DESCRIPTION
ZONE
ECO NO
APPROVED BY
DATE
LTR
A
LOAD CNTR 2 0410
LOAD CNTR 8 0370
CNTR
LOAD CNTR 32
0340 -LOW TAPE SIG
0401 -THREAD TU MTR DR
PS C620 R625 LC
FF 405 LC
FF 405 LC
FF 409 LC
FF 409 LC
FF 413 LC
LOADCNTR16
FF 413 LC
-LOAD CNTR 32 0400
0401 -RESET
0400 -COL VAC SET
O 622 LC
I 634 LC
-LOAD CNTR 16 0400
-LOAD CNTR 8 0400
0340 -BROKEN TAPE SIG
A 1036 LC
0400 THREAD
A 418 LC
-LONG LEADER CHECK 0370
LOAD CHECK
0410 -UNLOAD MEM
0400 -INIL RDY STAT
O 1036 LC
TOR CHK
FF 427 LC
LOAD CHK MEM 0371
0340 -TAPE ON REEL
A 422 LC
BROKEN TAPE SIGNAL
0340
0430 -CART PRESENT
A 422 LC
-BOT CHK
-RESET
FF 422 LC
I 1005 LC
SD Q1105 LC
-LOAD CHK LAMP DR
J/P52-64 0130
A 434 LC
PS C424 R420 LC
FF 431 LC
FF 431 LC
O 434 LC
A 427 LC
-BACKUP 0401 0410
0400 -LOAD SET
A 434 LC
-RETRY ABORT 0371
LOAD CIRCUITS
0390
2-79

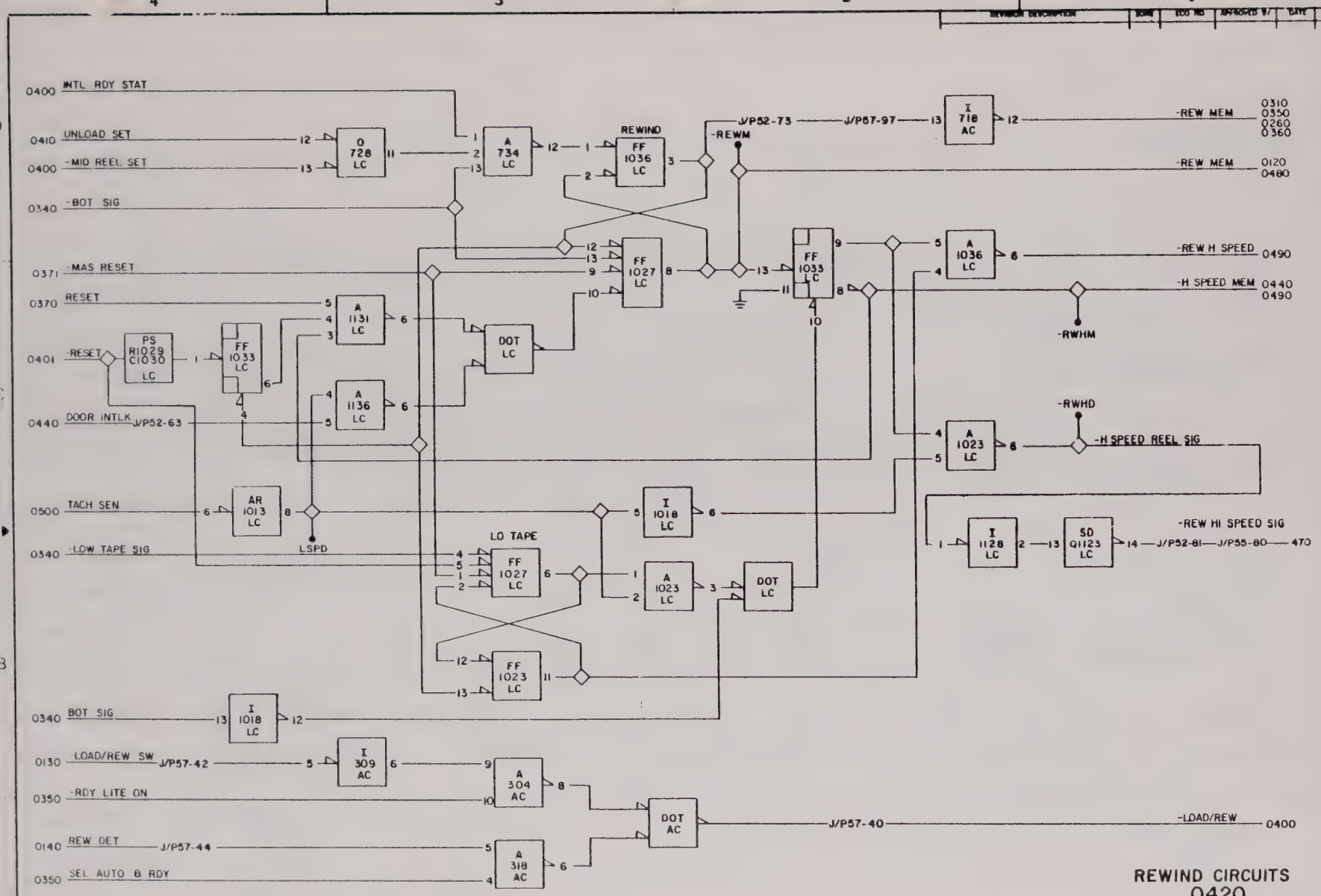


LOAD CIRCUITS
0400

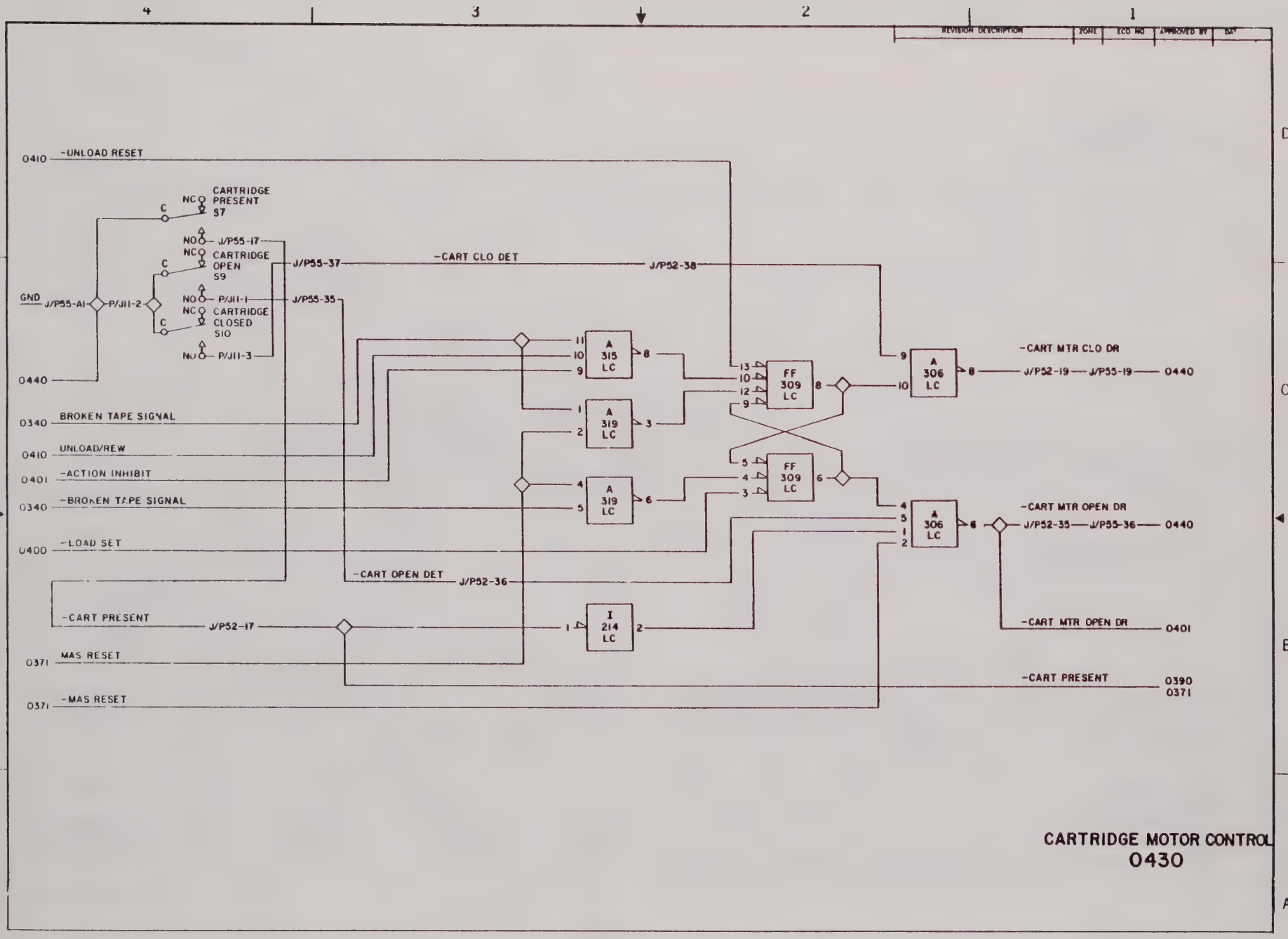


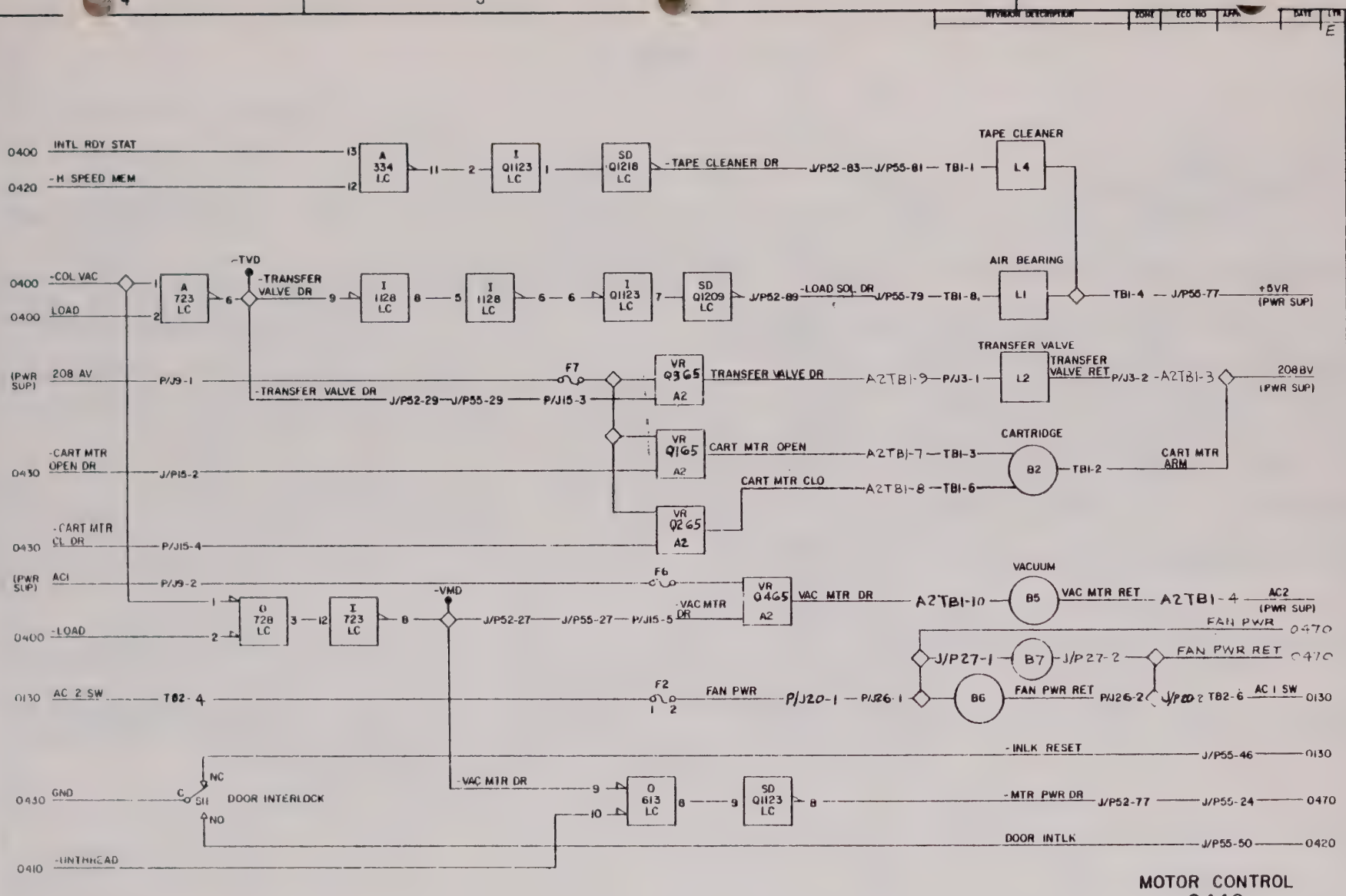
LOAD CIRCUITS
0401

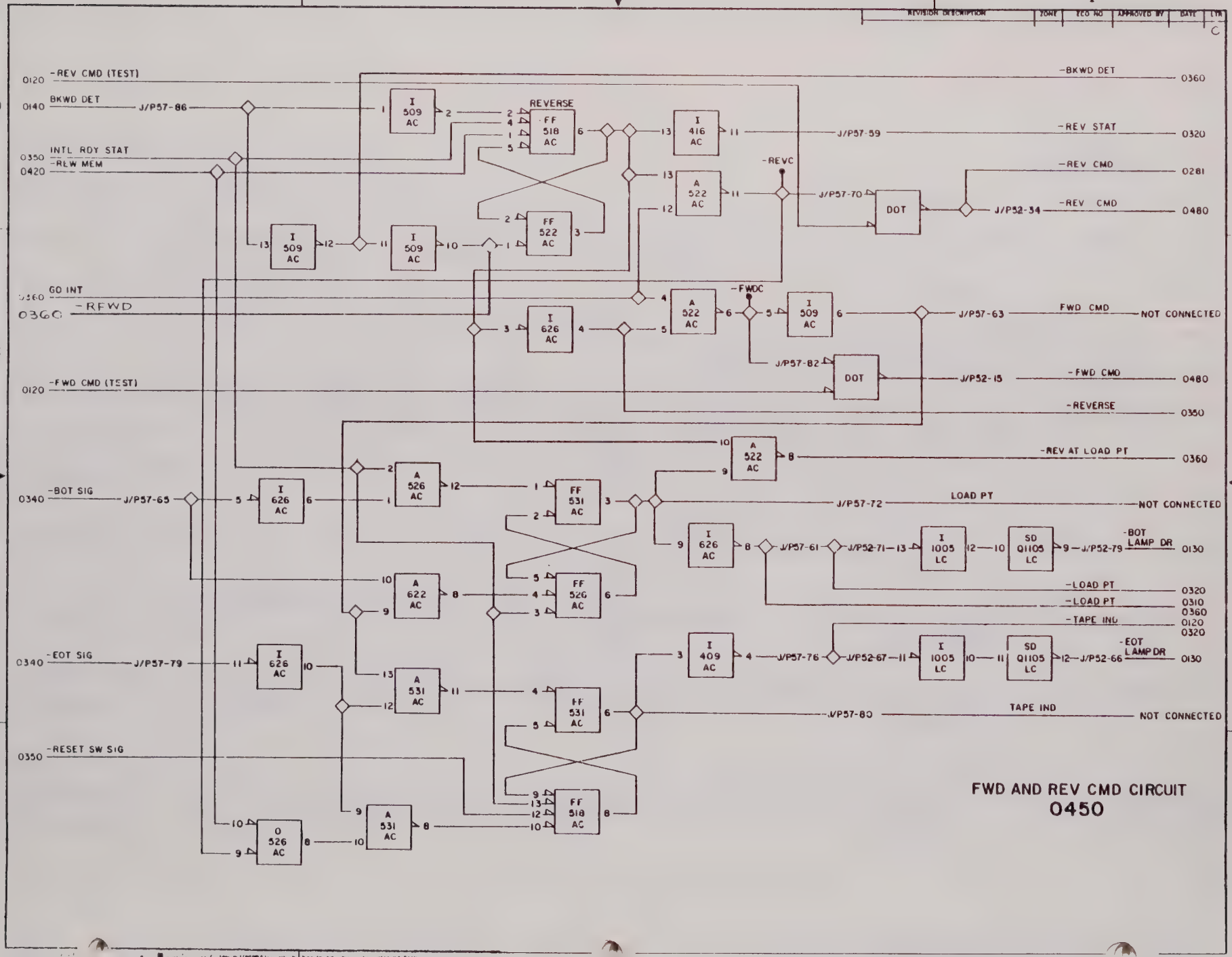

REVISION DESCRIPTION
ZONE
ECO NO
APPROVED BY
DATE
LTR
A
0400 -INTL RDY STAT
UNLOAD/REW
0401 -ACTION INHIBIT
0400 INTL RDY STAT
A 734 LC
UNLOAD
FF 728 LC
A 728 LC
UNLOAD MEM
0400
-UNTHREAD
0400
0440
0371 -MAS RESET
0401 -RESET
FF 731 LC
J/P52-61
-UNLOAD MEM
0350
-UNLOAD MEM
0390
0400
0390 LOAD CNTR 2
0340 BROKEN TAPE SIG
0390 -BACKUP
A 734 LC
O 627 LC
I 631 LC
J/P52-21
-UNTHREAD SUP MTR DR
J/P55-21
0460
I 634 LC
A 627 LC
O 627 LC
I 631 LC
DOT LC
J/P52-40
-UNTHREAD TU MTR DR
J/P55-39
0460
0330 TU TNK UP SAF DET
0401 -TU MTR NORM PWR
0400 NORM SERVO ENAB
A 608 LC
-UNLOAD RESET
0430
UNLOAD SET
0420
0140 REW UNLOAD DET
J/P57-41
0350 SEL AUTO & RDY
0350 -RDY LITE ON
0130 -UNLOAD REW SW
J/P57-58
A 318 AC
A 304 AC
I 309 AC
DOT AC
J/P57-46
-UNLOAD/REW
J/P52-41
I 709 LC
UNLOAD/REW
0430
UNLOAD CIRCUITS
0410
2-82

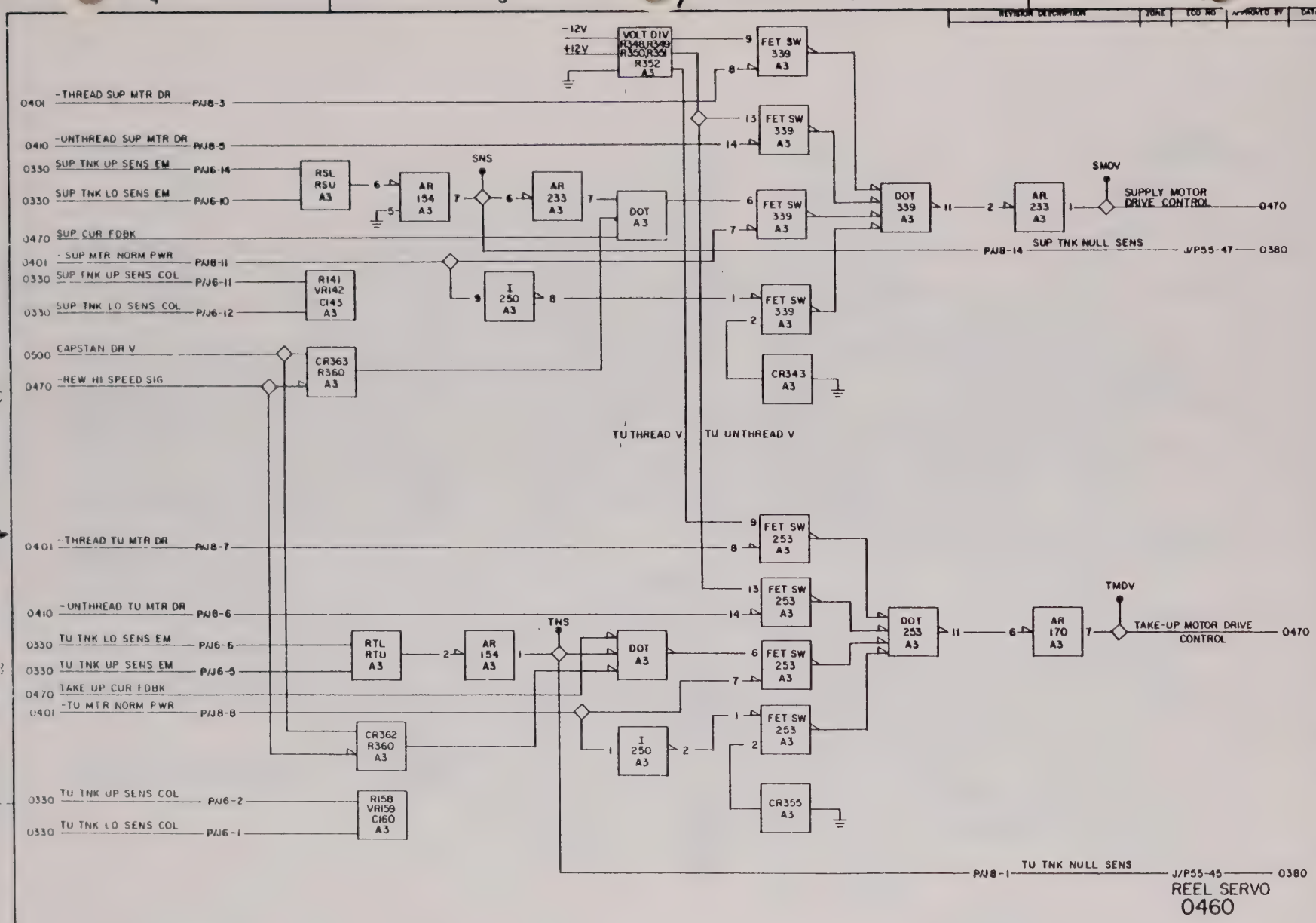


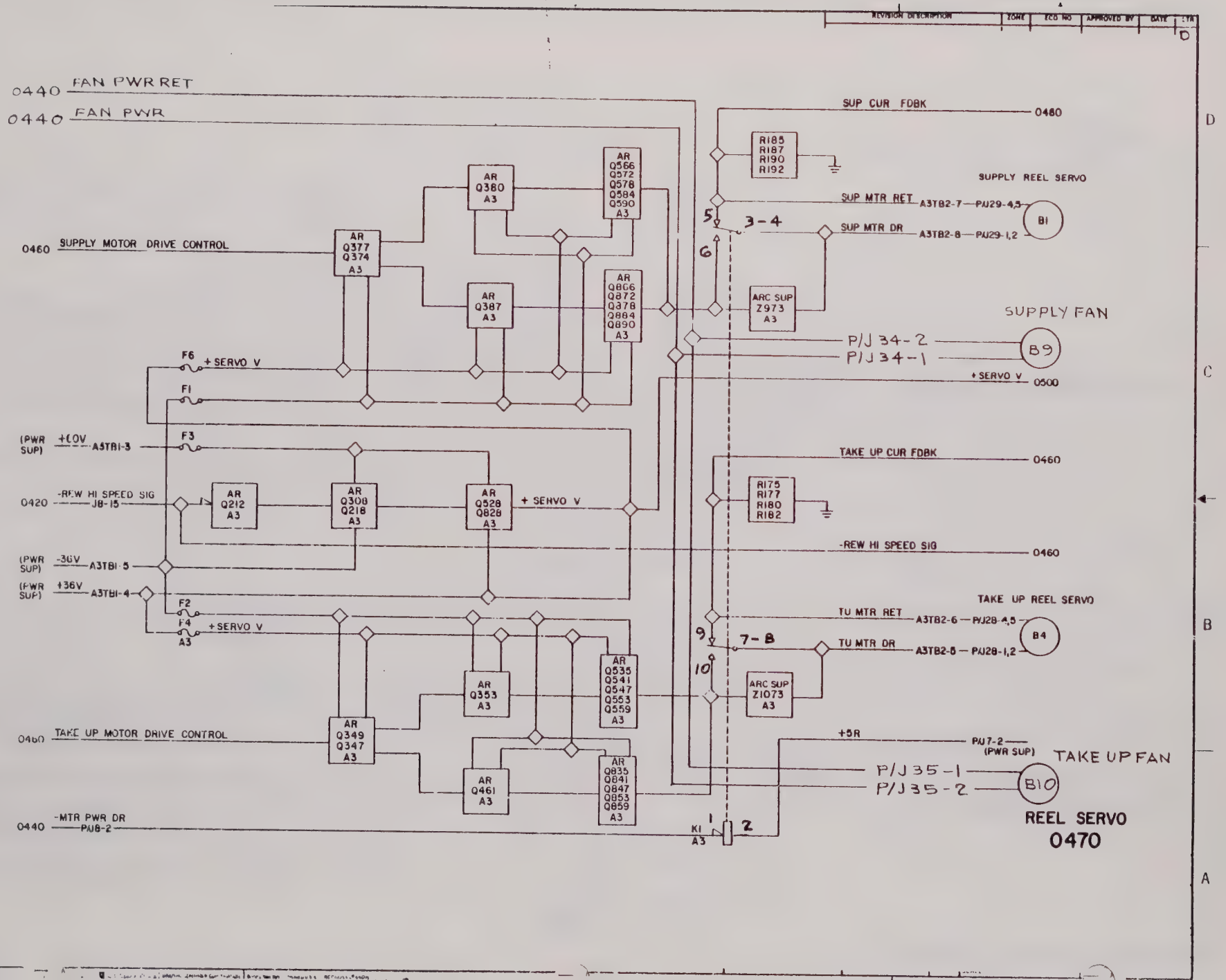
REWIND CIRCUITS
0420

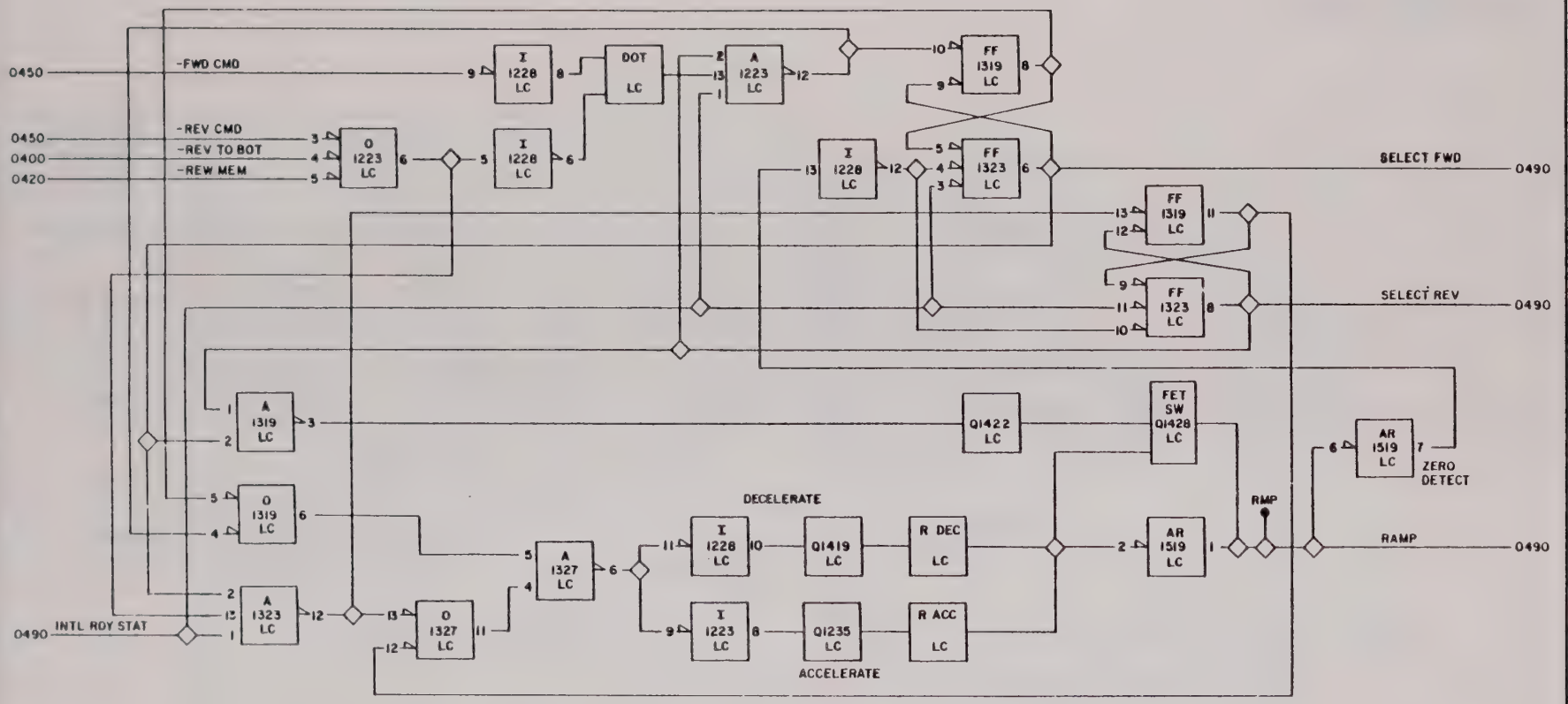

REVISION DESCRIPTION
ZONE
ECO NO
APPROVED BY
DAT
0410 -UNLOAD RESET
CARTRIDGE PRESENT S7
NC
NO
C
J/P55-17
CARTRIDGE OPEN S9
J/P55-37
-CART CLO DET
J/P52-38
GND
J/P55-A1
P/J11-2
P/J11-1
J/P55-35
CARTRIDGE CLOSED S10
P/J11-3
0440
0340 BROKEN TAPE SIGNAL
0410 UNLOAD/REW
0401 -ACTION INHIBIT
0340 -BROKEN TAPE SIGNAL
0400 -LOAD SET
A 315 LC
A 319 LC
A 319 LC
FF 309 LC
FF 309 LC
A 306 LC
A 306 LC
-CART MTR CLO DR
J/P52-19 J/P55-19 0440
-CART MTR OPEN DR
J/P52-35 J/P55-36 0440
-CART MTR OPEN DR 0401
-CART OPEN DET
J/P52-36
-CART PRESENT
J/P52-17
I 214 LC
0371 MAS RESET
0371 -MAS RESET
-CART PRESENT 0390 0371
CARTRIDGE MOTOR CONTROL
0430


REVISION DESCRIPTION
ZONE
ECO NO
APP
DATE
LTR
0400 INTL RDY STAT
0420 -H SPEED MEM
A 334 LC
I Q1123 LC
SD Q1218 LC
-TAPE CLEANER DR
J/P52-83
J/P55-81
TB1-1
TAPE CLEANER
L4
-TVD
0400 -COL VAC
0400 LOAD
A 723 LC
-TRANSFER VALVE DR
I 1128 LC
I 1128 LC
I Q1123 LC
SD Q1209 LC
J/P52-89
-LOAD SOL DR
J/P55-79
TB1-8
AIR BEARING
L1
TB1-4
J/P55-77
+5VR (PWR SUP)
(PWR SUP) 208 AV
P/J9-1
F7
VR Q365 A2
TRANSFER VALVE DR
A2TB1-9
P/J3-1
TRANSFER VALVE
L2
TRANSFER VALVE RET
P/J3-2
A2TB1-3
208BV (PWR SUP)
-TRANSFER VALVE DR
J/P52-29
J/P55-29
P/J15-3
0430 -CART MTR OPEN DR
J/P15-2
VR Q165 A2
CART MTR OPEN
A2TB1-7
TB1-3
CARTRIDGE
B2
TB1-2
CART MTR ARM
CART MTR CLO
A2TB1-8
TB1-6
0430 -CART MTR CL DR
P/J15-4
VR Q265 A2
(PWR SUP) AC1
P/J9-2
F6
VR Q465 A2
VAC MTR DR
A2TB1-10
VACUUM
B5
VAC MTR RET
A2TB1-4
AC2 (PWR SUP)
-VMD
0400 -LOAD
O 728 LC
I 723 LC
-VAC MTR DR
J/P52-27
J/P55-27
P/J15-5
FAN PWR
0470
J/P27-1
B7
J/P27-2
FAN PWR RET
0470
0130 AC 2 SW
T82-4
F2
FAN PWR
P/J20-1
P/J26-1
B6
FAN PWR RET
P/J26-2
J/P00-2
T82-6
AC 1 SW
0130
-INLK RESET
J/P55-46
0130
0430 GND
NC
C
SW
NO
DOOR INTERLOCK
VAC MTR DR
O 613 LC
SD Q1123 LC
-MTR PWR DR
J/P52-77
J/P55-24
0470
DOOR INTLK
J/P55-50
0420
0410 -UNTHREAD
MOTOR CONTROL
0440


REVISION DESCRIPTION
ZONE
ECO NO
APPROVED BY
DATE
LTR
0120 -REV CMD (TEST)
0140 BKWD DET
J/P57-86
0350 INTL RDY STAT
0420 -REW MEM
REVERSE
-BKWD DET 0360
-REV STAT 0320
-REVC
-REV CMD 0281
-REV CMD 0480
J/P57-59
J/P57-70
J/P52-34
DOT
0360 GO INT
0360 -REWD
-FWDC
FWD CMD
NOT CONNECTED
J/P57-63
J/P57-82
J/P52-15
-FWD CMD 0480
0120 -FWD CMD (TEST)
-REVERSE 0350
-REV AT LOAD PT 0360
0340 -BOT SIG
J/P57-65
J/P57-72
LOAD PT
NOT CONNECTED
J/P57-61
J/P52-71
J/P52-79
-BOT LAMP DR 0130
-LOAD PT 0320
-LOAD PT 0310
0360
-TAPE IND 0120
0320
0340 -EOT SIG
J/P57-79
J/P57-76
J/P52-67
J/P52-66
-EOT LAMP DR 0130
J/P57-80
TAPE IND
NOT CONNECTED
0350 -RESET SW SIG
FWD AND REV CMD CIRCUIT
0450

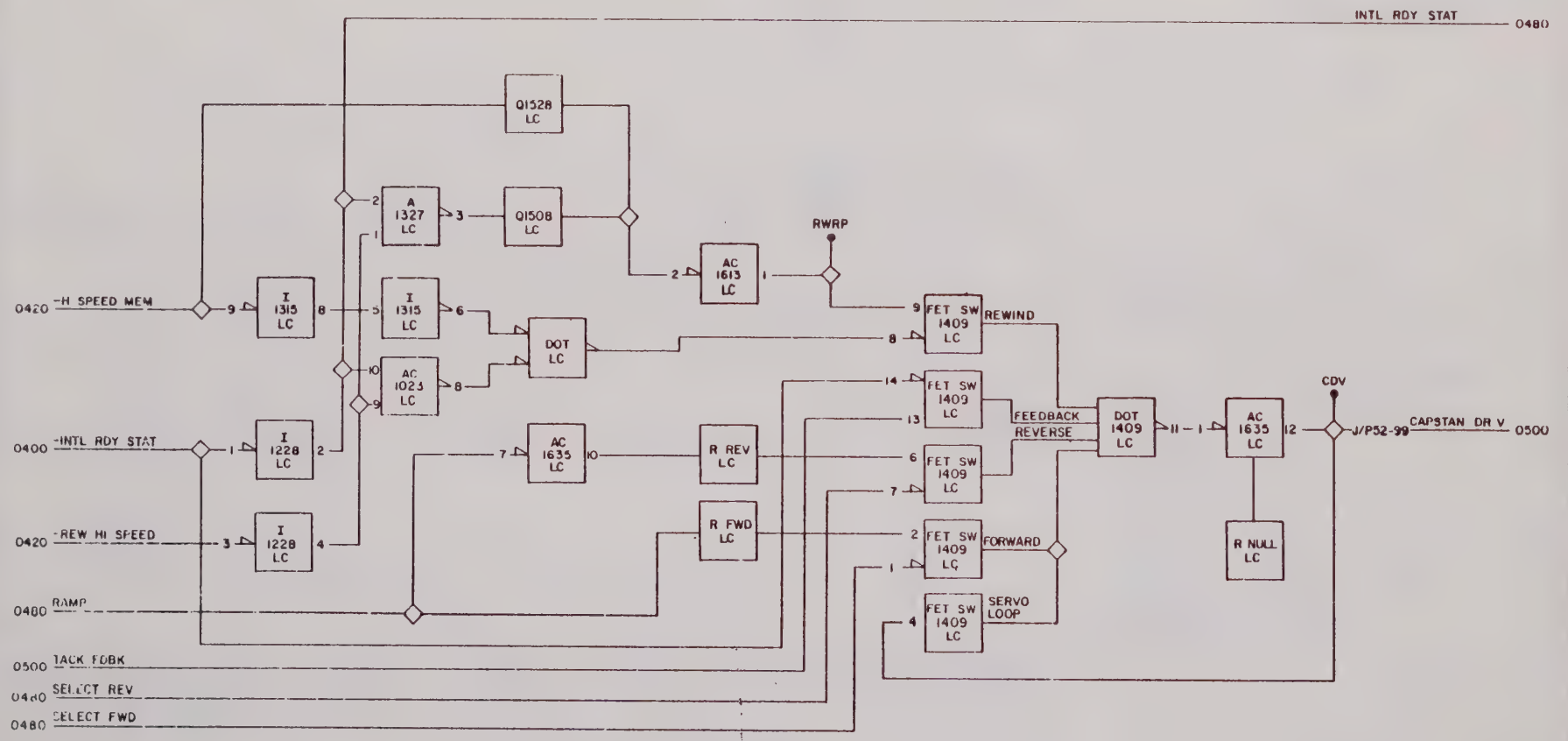

-12V
+12V
VOLT DIV R348,R349 R350,R351 R352 A3
FET SW 339 A3
FET SW 253 A3
0401 -THREAD SUP MTR DR PJ8-3
0410 -UNTHREAD SUP MTR DR PJ8-5
0330 SUP TNK UP SENS EM PJ6-14
0330 SUP TNK LO SENS EM PJ6-10
0470 SUP CUR FDBK
0401 -SUP MTR NORM PWR PJ8-11
0330 SUP TNK UP SENS COL PJ6-11
0330 SUP TNK LO SENS COL PJ6-12
RSL RSU A3
AR 154 A3
AR 233 A3
SNS
DOT A3
DOT 339 A3
DOT 253 A3
SMDV
SUPPLY MOTOR DRIVE CONTROL 0470
PJ8-14 SUP TNK NULL SENS J/P55-47 0380
R141 VR142 C143 A3
I 250 A3
CR343 A3
0500 CAPSTAN DR V
0470 -REW HI SPEED SIG
CR363 R360 A3
TU THREAD V
TU UNTHREAD V
0401 -THREAD TU MTR DR PJ8-7
0410 -UNTHREAD TU MTR DR PJ8-6
0330 TU TNK LO SENS EM PJ6-6
0330 TU TNK UP SENS EM PJ6-5
0470 TAKE UP CUR FDBK
0401 -TU MTR NORM PWR PJ8-8
RTL RTU A3
TNS
CR362 R360 A3
CR355 A3
TMDV
AR 170 A3
TAKE-UP MOTOR DRIVE CONTROL 0470
0330 TU TNK UP SENS COL PJ6-2
0330 TU TNK LO SENS COL PJ6-1
R158 VR159 C160 A3
PJ8-1 TU TNK NULL SENS J/P55-45 0380
REEL SERVO
0460


REVISION DESCRIPTION
ZONE
ECO NO
APPROVED BY
DATE
ITR
0440 FAN PWR RET
0440 FAN PWR
0460 SUPPLY MOTOR DRIVE CONTROL
AR Q377 Q374 A3
AR Q380 A3
AR Q387 A3
AR Q566 Q572 Q578 Q584 Q590 A3
AR Q866 Q872 Q878 Q884 Q890 A3
F6 +SERVO V
F1
(PWR SUP) +10V A3TB1-3
F3
0420 -REW HI SPEED SIG J8-15
AR Q212 A3
AR Q308 Q218 A3
AR Q528 Q828 A3
+SERVO V
(PWR SUP) -36V A3TB1-5
(PWR SUP) +36V A3TB1-4
F2
F4
A3
+SERVO V
0460 TAKE UP MOTOR DRIVE CONTROL
AR Q349 Q347 A3
AR Q353 A3
AR Q461 A3
AR Q535 Q541 Q547 Q553 Q559 A3
AR Q835 Q841 Q847 Q853 Q859 A3
0440 -MTR PWR DR PJ8-2
K1 A3
1
2
SUP CUR FDBK 0480
R185 R187 R190 R192
SUPPLY REEL SERVO
SUP MTR RET A3TB2-7 PJ29-4,5
SUP MTR DR A3TB2-8 PJ29-1,2
B1
5
3-4
6
ARC SUP Z973 A3
SUPPLY FAN
P/J 34-2
P/J 34-1
B9
+SERVO V 0500
TAKE UP CUR FDBK 0460
R175 R177 R180 R182
-REW HI SPEED SIG 0460
TAKE UP REEL SERVO
TU MTR RET A3TB2-6 PJ28-4,5
TU MTR DR A3TB2-5 PJ28-1,2
B4
9
7-8
10
ARC SUP Z1073 A3
+5R PJ7-2 (PWR SUP)
TAKE UP FAN
P/J 35-1
P/J 35-2
B10
REEL SERVO
0470

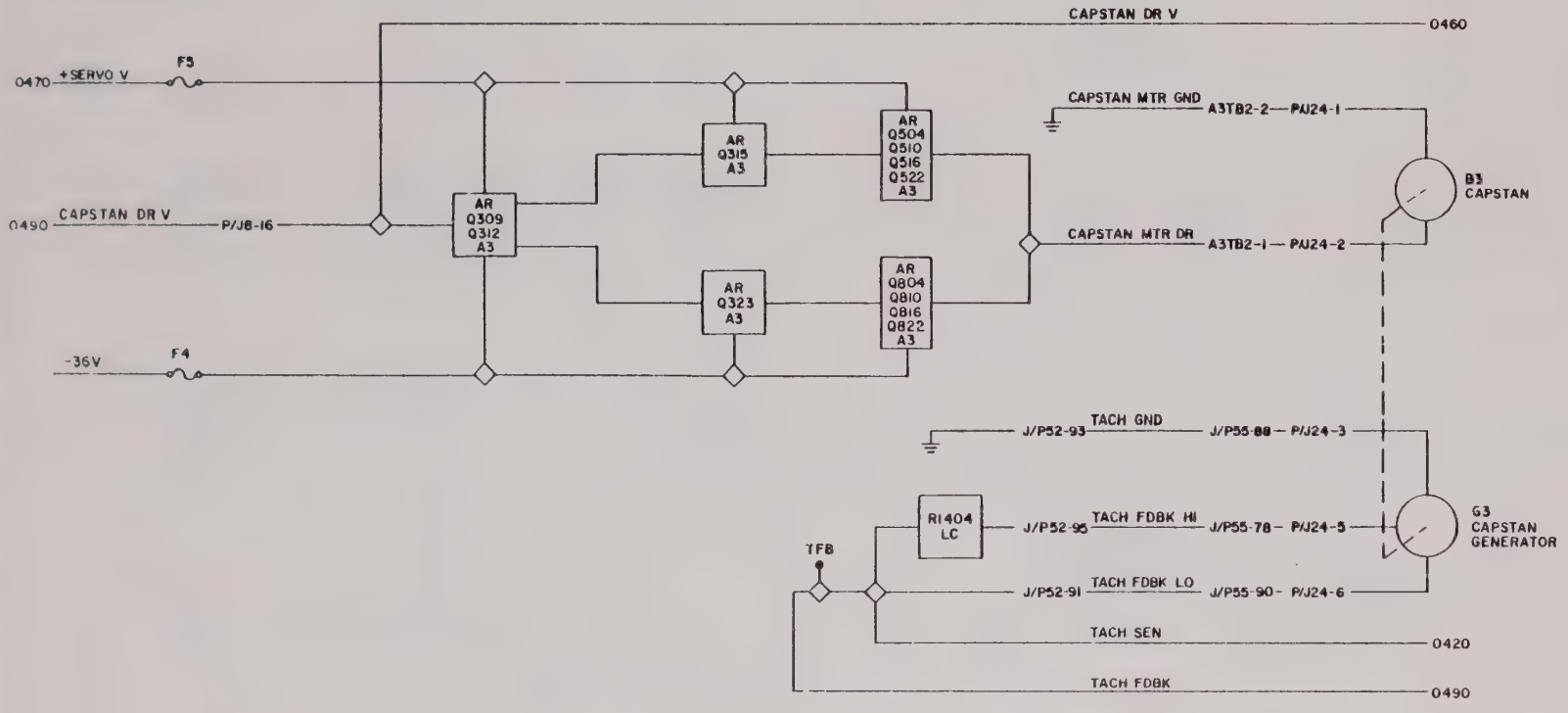


CAPSTAN DRIVE CIRCUIT
0480

REVISION DESCRIPTION	ZONE	ECO NO	APPROVED BY	DATE	LTR
					A



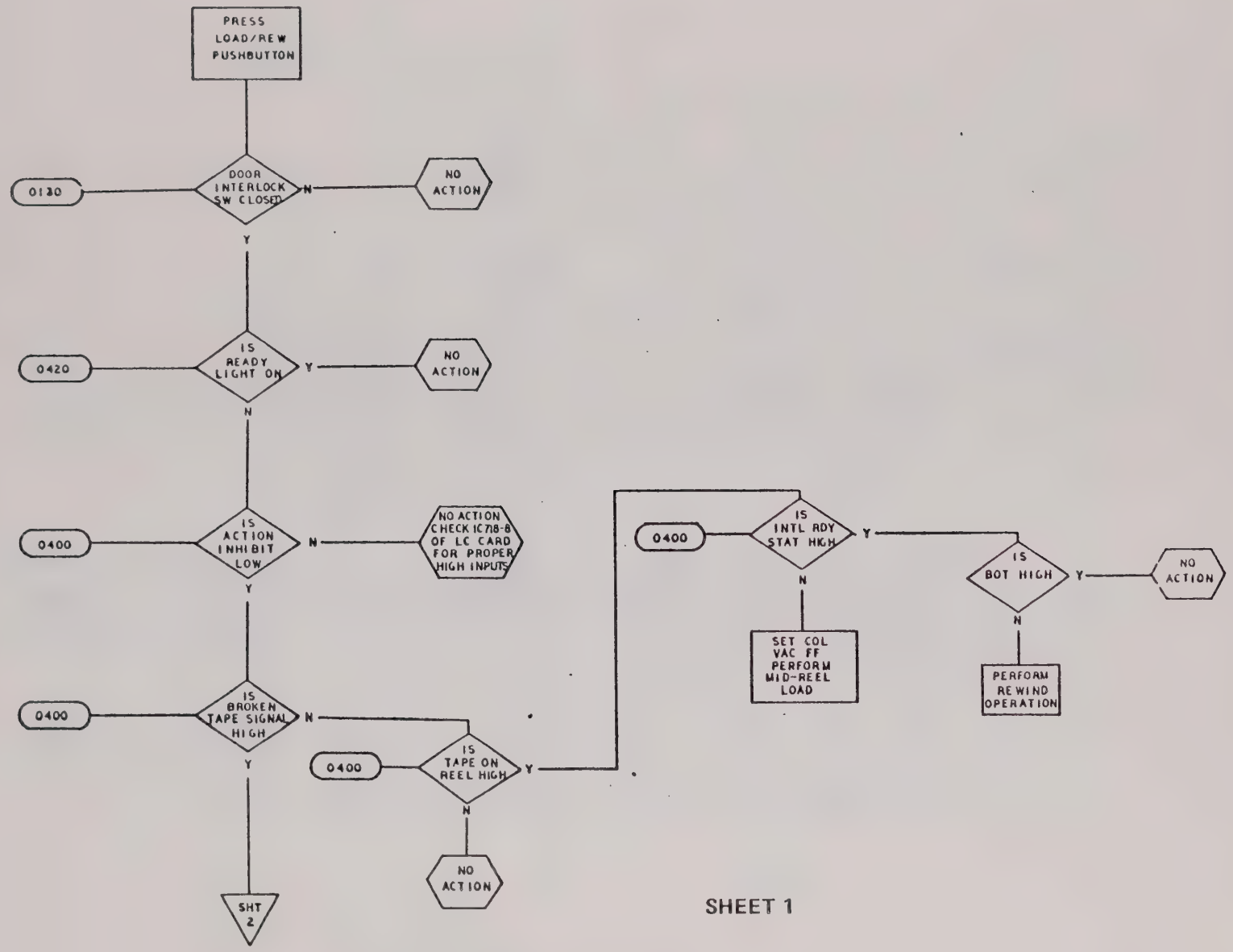
CAPSTAN DRIVE CIRCUIT
0490



CAPSTAN DRIVE CIRCUIT
0500

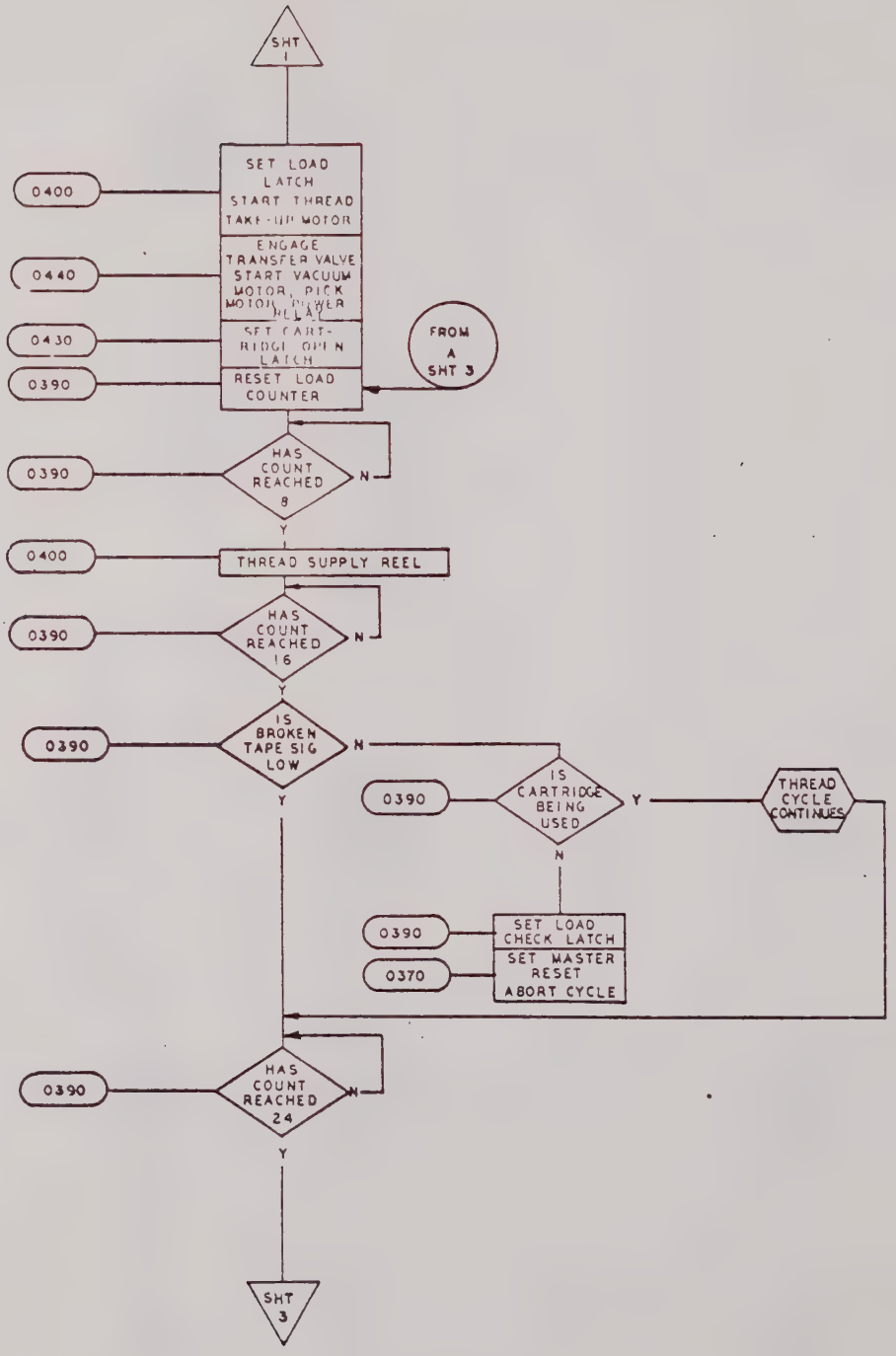
2-91/2-92

LOAD OPERATION FLOW DIAGRAM



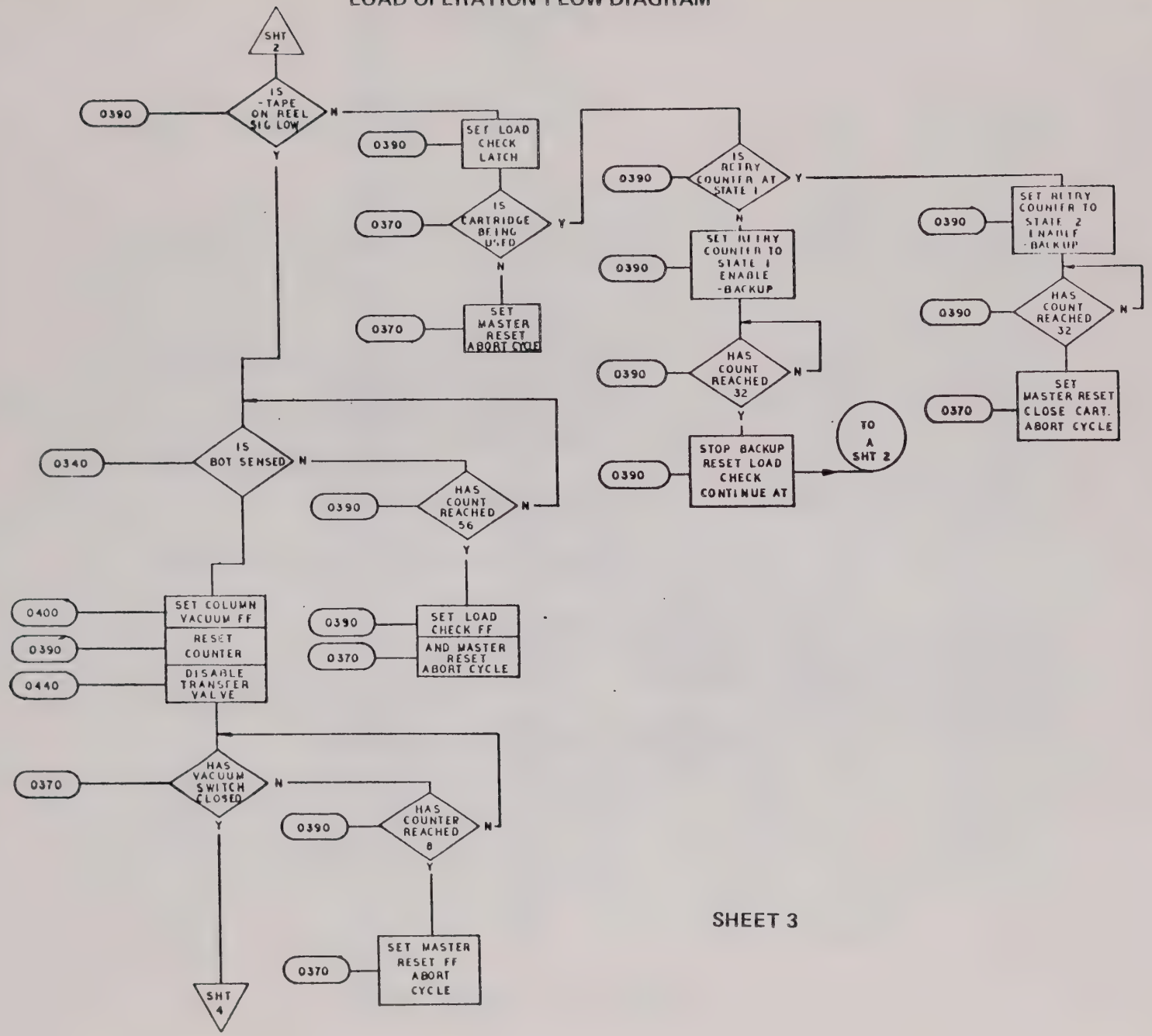
SHEET 1

LOAD OPERATION FLOW DIAGRAM



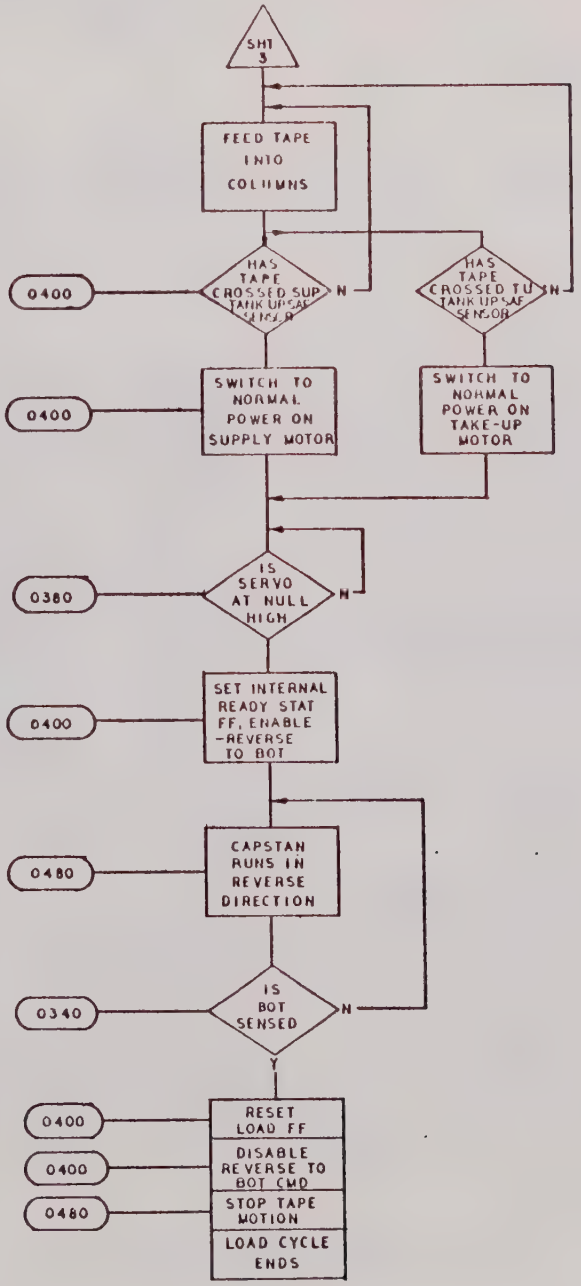
SHEET 2

LOAD OPERATION FLOW DIAGRAM



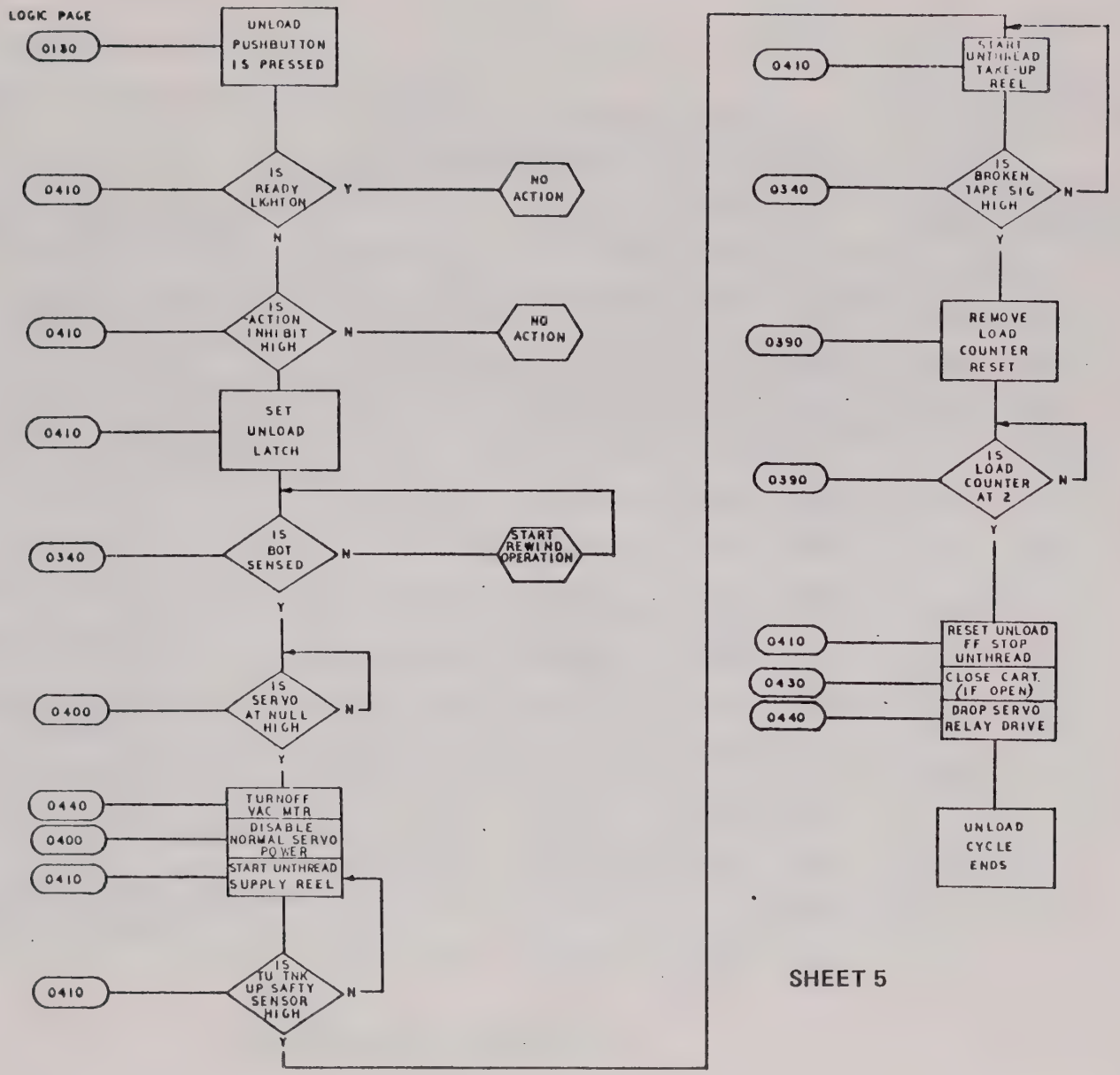
SHEET 3

LOAD OPERATION FLOW DIAGRAM



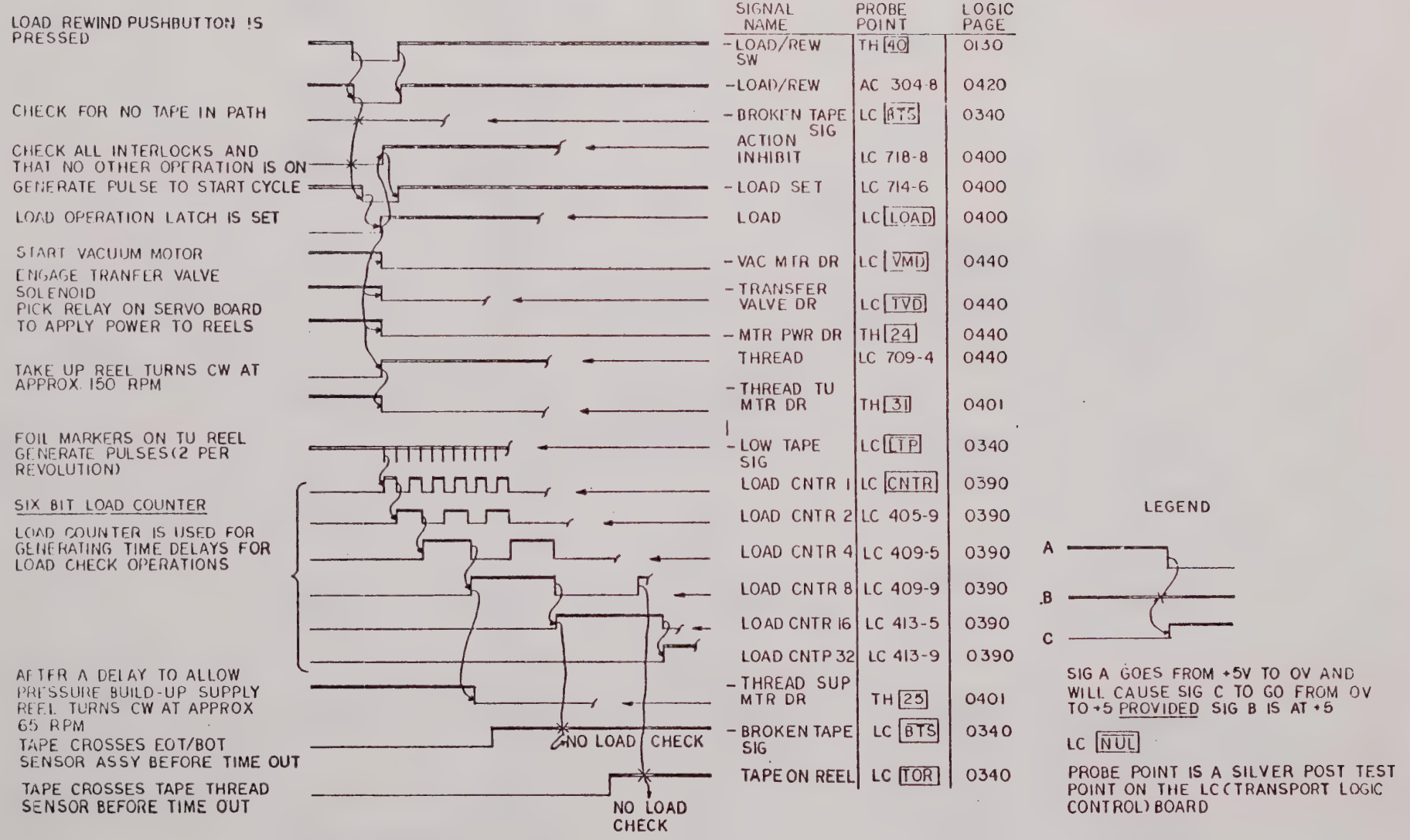
SHEET 4

UNLOAD OPERATION TIMING DIAGRAM



SHEET 5

LOAD OPERATION FLOW DIAGRAM



LOAD OPERATION CONTINUES ON SHEET 2

LEGEND

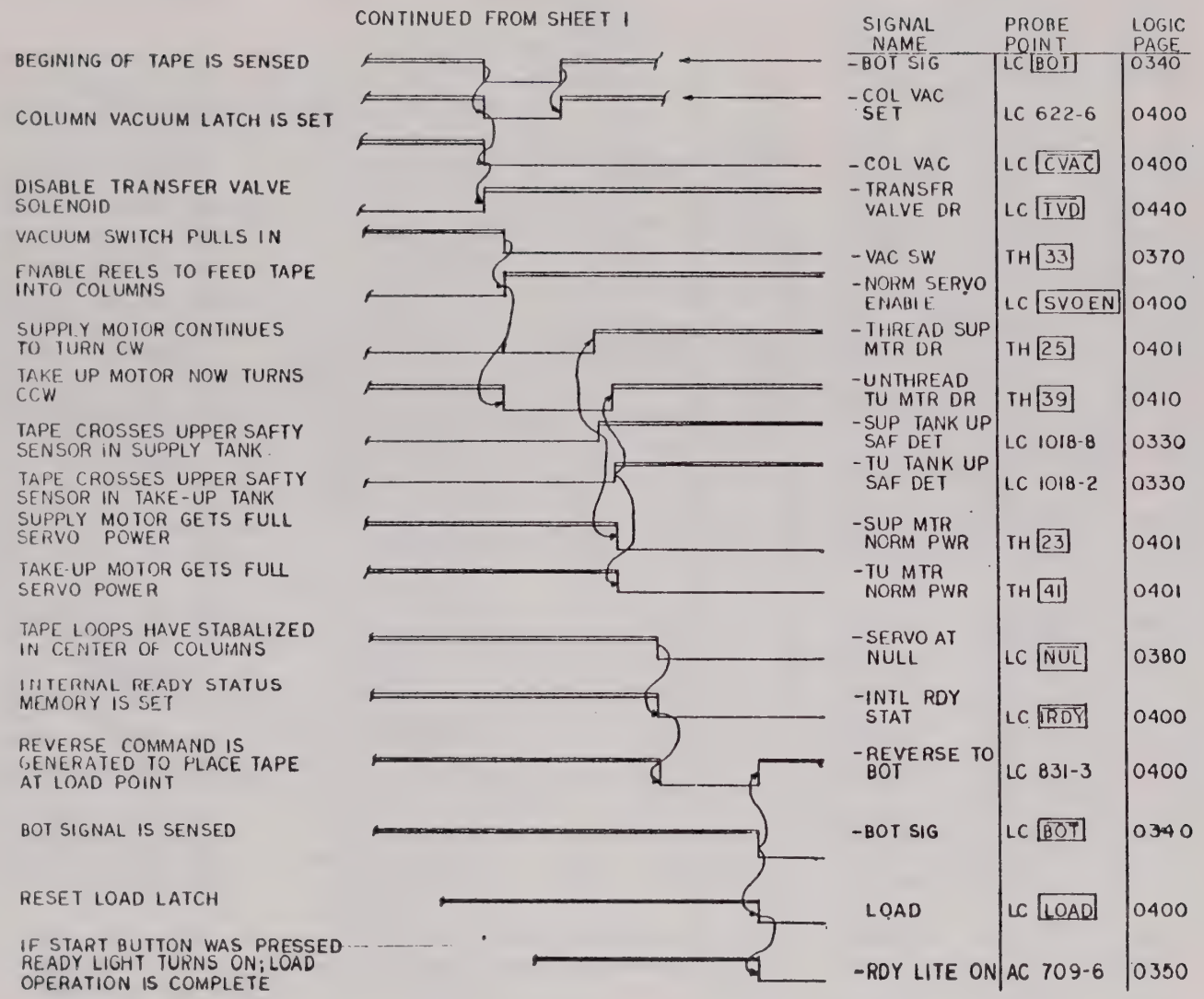
SIG A GOES FROM +5V TO 0V AND WILL CAUSE SIG C TO GO FROM 0V TO +5 PROVIDED SIG B IS AT +5

LC NUL

PROBE POINT IS A SILVER POST TEST POINT ON THE LC (TRANSPORT LOGIC CONTROL) BOARD

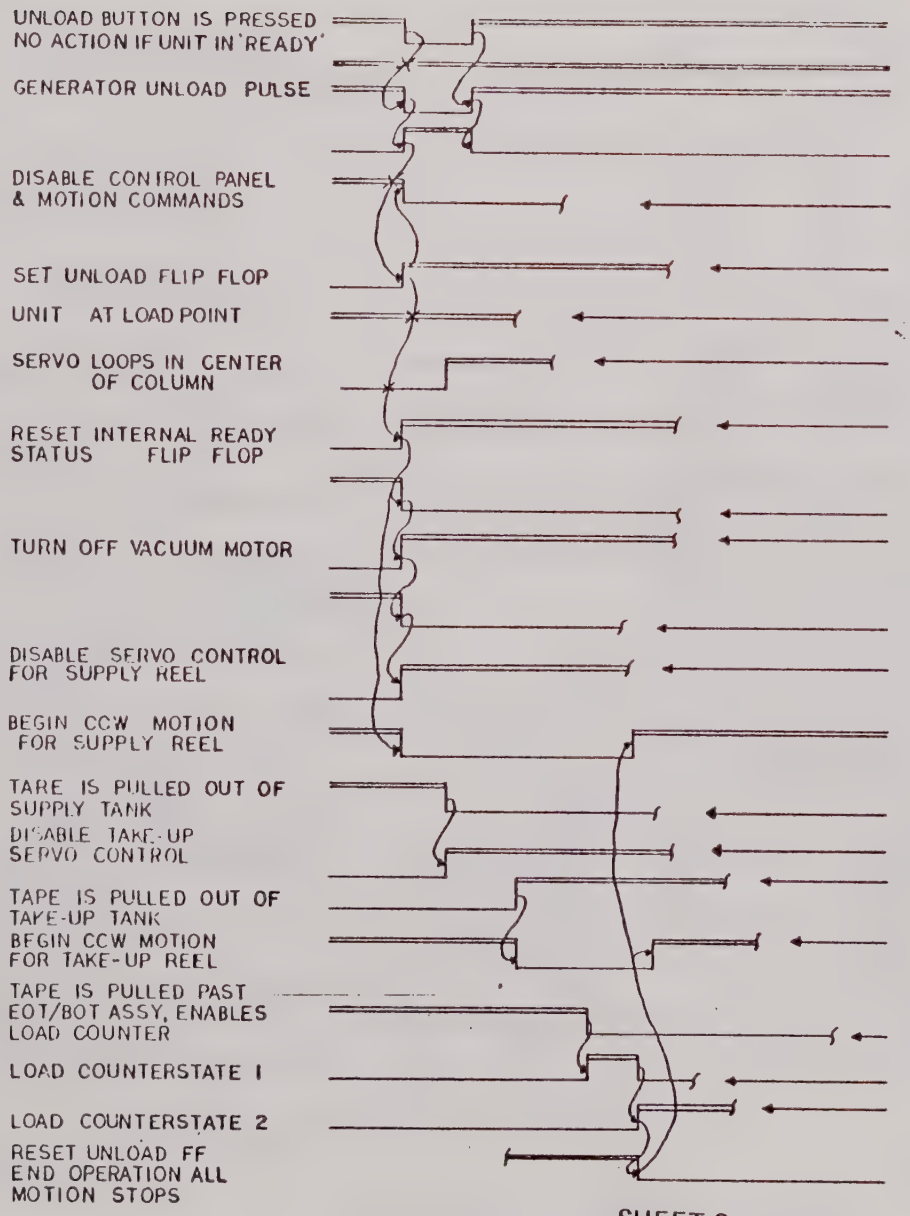
SHEET 1

LOAD OPERATION TIMING DIAGRAM



SHEET 2

UNLOAD OPERATION TIMING DIAGRAM


UNLOAD BUTTON IS PRESSED NO ACTION IF UNIT IN 'READY'
GENERATOR UNLOAD PULSE
DISABLE CONTROL PANEL & MOTION COMMANDS
SET UNLOAD FLIP FLOP
UNIT AT LOAD POINT
SERVO LOOPS IN CENTER OF COLUMN
RESET INTERNAL READY STATUS FLIP FLOP
TURN OFF VACUUM MOTOR
DISABLE SERVO CONTROL FOR SUPPLY REEL
BEGIN CCW MOTION FOR SUPPLY REEL
TAPE IS PULLED OUT OF SUPPLY TANK
DISABLE TAKE-UP SERVO CONTROL
TAPE IS PULLED OUT OF TAKE-UP TANK
BEGIN CCW MOTION FOR TAKE-UP REEL
TAPE IS PULLED PAST EOT/BOT ASSY, ENABLES LOAD COUNTER
LOAD COUNTERSTATE 1
LOAD COUNTERSTATE 2
RESET UNLOAD FF END OPERATION ALL MOTION STOPS

SIGNAL NAME	PROBE POINT	LOGIC PAGE
-UNLOAD/REW SW	TH 10	0130
-RDY LITE ON	AC 304-12	0140
-UNLOAD/ REW	LC 709-1	0410
UNLOAD/ REW	LC 734-3	0410
-ACTION INHIBIT	LC 734-5	0410
UNLOAD MEM	LC 728-8	0410
BOT SIG	LC 834-11	0340
-SERVO AT NULL	LC NUL	0380
-INTL RDY	LC IRDY	0400
UNTHREAD	LC 728-6	0410
-COL VAC	LC CVAC	0400
NORM SERVO ENABLE	LC SVO EN	0400
SUP MTR NORM PWR	TH 23	0401
-UNTHREAD SUP MTR DR	TH 21	0410
-SUP TNK UP SAF DET	LC 1132-2	0401
-TU MTR NORM PWR	TH 41	0401
TU TNK UP SAF DET	LC 627-2	0401
UNTHREAD TU MTR DR	TH 39	0410
-BROKEN TAPE SIGNAL	LC BTS	0340
LOAD CNTR 1	LC CNTR	0390
LOAD CNTR 2	LC 405-9	0390
UNLOAD MEM	LC 728-8	0410

SHEET 3

SECTION III

OPERATION

3.1 GENERAL

This section provides a description of all the controls, indicators, and fuses contained in the MTD. In addition, tape loading and unloading, and operating procedures are provided.

3.2 CONTROLS, INDICATORS, AND FUSES

The controls and indicators of the MTD are located in two places. Those controls which are used regularly, as well as the status indicators, are located on the control panel of the MTD. These are illustrated in Figure 3-1 and 3-2. These controls are described in Table 3-1 on the next page. Those controls which are used for testing MTD, and are not used during normal operation, are located on Transport Logic module (P52), Figure 3-3, and are described in Table 3-2 on page 3-3.

3.3 TURN-ON PROCEDURE

To turn power on to the MTD and prepare it for operation, perform the following procedure:

a. Insure that the Cycle/Run toggle switch (S4) on the Transport Logic module (P52) (Figure 3-3) is in its OFF (center) position.

b. Depress the Power ON-OFF switch on the control panel (Figure 3-1) to the ON position.

3.4 TAPE LOADING PROCEDURE

To load a tape into the MTD, perform the following procedure:

a. Open dust cover.

b. Press reel lock lever (Figure 1-2) to its inward position, and place supply reel in position. If reel does not have a cartridge, place end of tape into the threading chute. If reel has a cartridge, place reel on hub so that protrusions from cartridge fit into the two reel positioning guides. The pin from cartridge motor face plate should go into tape cartridge opening. Press reel lock lever again and it will lock the tape reel in position, with the lever locked in its outer position (flush with hub surface).

c. Close dust cover.

d. Depress LOAD/RWD switch. This will cause the tape to be automatically loaded.

e. When tape motion stops and BOT indicator is lit, the MTD is in a standby mode.

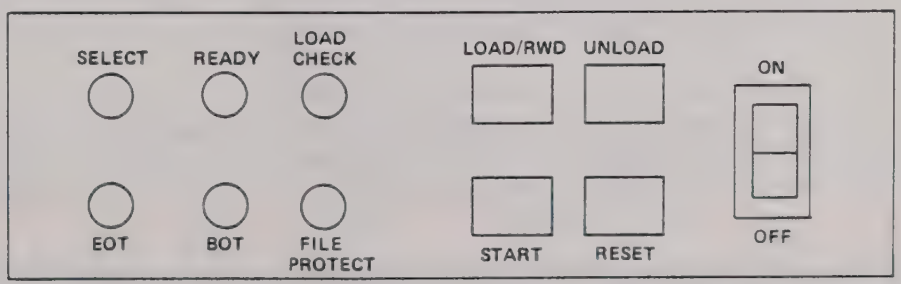


Figure 3-1. Control Panel (Single Density), Switches and Indicators

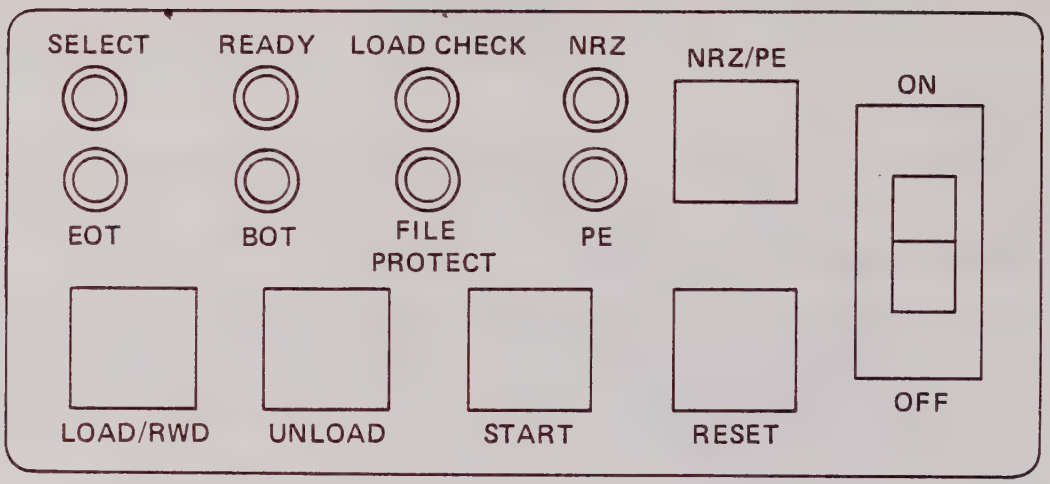


Figure 3-2. Control Panel Switches and Indicators (Dual Density)

Table 3-1. Front Panel Switches and Indicators (Figure 3-1 & 3-2)

Switches/Indicator	Function
SELECT	This white status indicator is lit when the computer has selected the MTD.
READY	This white status indicator is lit when the MTD is ready for operation and the START switch has been depressed.
LOAD CHECK	This white status indicator is lit when a failure has been detected during loading operations.
LOAD/RWD	White momentary switch, when depressed, loads tape from the supply reel to the take-up reel. Once the tape is loaded, the MTD goes into a standby mode. If tape is already loaded, but the MTD is not ready, depressing this switch causes the tape to rewind to load point.
UNLOAD	White momentary switch, when depressed, causes the MTD to rewind and then unload the tape from the take-up reel back onto the supply reel.
ON-OFF	This rocker switch enables input AC power to be applied to the MTD power transformer and thus generate internal operating voltages.
RESET	Blue momentary switch, which, when depressed, causes the MTD to halt and enables the operator to gain local control. This switch overrides any other MTD operation. NOTE: When in high speed rewind, if this switch is depressed momentarily, the MTD switches from high speed to normal reverse speed. The switch must be momentarily depressed again to stop the MTD.
NRZ/PE*	When depressed, this switch changes density mode of MTD (only on dual density units).

Table 3-1. Front Panel Switches and Indicators (Figure 3-1 & 3-2) (Cont'd.)

NRZ	When lit, indicates the MTD is in NRZI mode (only on dual density units).
PE	When lit, indicates the MTD is in PE mode (only on dual density units).
START	Green momentary switch, when depressed and tape is loaded, causes the MTD to be turned over to computer control. READY lamp should go on.
FILE PROTECT	This white status indicator is lit when the unit is not ready, rewinding or when the MTD is ready but the write enable ring is not installed on the supply reel. Under this condition, the MTD will not write on tape. In order to write on tape, the write enable ring must be installed.
BOT	This white status indicator is lit whenever the tape is positioned at the BOT marker.
EOT	This white status indicator is lit when the EOT marker on the tape has been reached and remains on until the tape is rewound past the EOT marker.

*NOTE: If this switch is not enabled, density must be selected by the controlling device.

Table 3-2. Local Test Mode Controls
(Located on Transport Logic Module) (P52) refer to Figure 3-3

Control	Function
SET WRITE STATUS switch (S1)	Locking pushbutton switch. During test operations, depressing this switch places the MTD in a writing mode. A reverse or rewind operation will reset the MTD to a read mode. If the switch is locked in (rotated) the MTD will return to a write mode, automatically, when rewind or reverse operation is completed.
DENSITY switch (S2)	Two-position toggle switch. During test operations, this switch will select recording density; either low (up) or high (down).
PE–NRZ Switch (S3)	Two-position toggle switch. During test operations, this switch selects the correct write clock for recording either PE (up) or NRZ (down). The front panel density switch (on Dual Density versions) must indicate the same selection for proper write current levels in Local mode.
CYCLE/RUN switch (S4)	Three-position toggle switch which should be in Off (center) position during normal operation. When placed in Cycle (down) position, the switch is connected to the output of an oscillator and causes generation of a chain of either forward or reverse commands depending on the position of the FWD/REV switch (S5). When placed in RUN (up) position, the switch is connected to ground and causes generation of either a continuous forward or a continuous reverse command depending on the position of switch S5.
FWD/REV Switch (S5)	Two-position toggle switch. When in REV (up) position, causes generation of reverse command. When in FWD (down) position, causes generation of forward command. During normal operation, switch S4 (being Off) keeps this switch inactive.

Table 3-2. Local Test Mode Controls (Cont'd.)

CONTROL	FUNCTION
FREQ POT (R340B)*	Adjusts frequency of Run/Stop generator.
DUTY CYCLE POT (R340A)*	Adjusts duty cycle of Run/Stop generator.

*Note: If FREQ and DUTY pots are adjusted to their extremes, the MTD will not cycle.
i.e.: If DUTY pot is set to minimum – tape motion will not occur, or
If DUTY pot is set to maximum – continuous tape motion will occur.

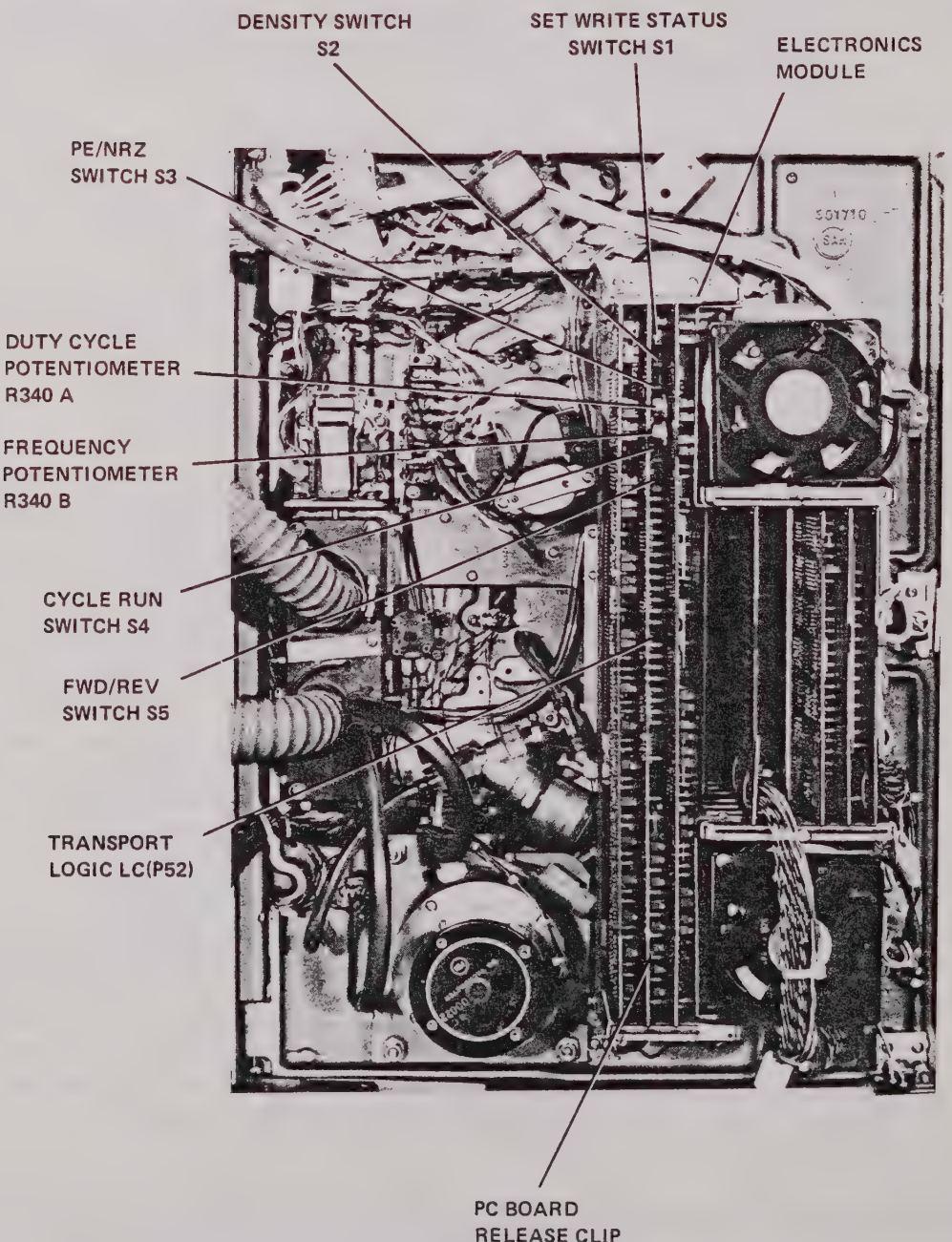


Figure 3-3. Test Function Generator (LOCAL) Controls

3.5 TAPE UNLOADING PROCEDURE

To unload a tape from the MTD, perform the following procedure:

a. Depress RESET switch to gain local control of the MTD.

b. Depress UNLOAD switch.

c. When tape has been taken up on the supply reel, open dust cover, and remove tape by pressing reel lock lever and pulling reel off supply hub.

3.6 OPERATING PROCEDURES

To operate the MTD, perform the following procedure:

a. Turn on MTD in accordance with paragraph 3.3

b. Load tape in accordance with paragraph 3.4.

c. Once tape is loaded, observe status indicators on top of control panel. They should all be off except for the FILE PROTECT indicator, and BOT indicator. Select light may be on.

d. Depress START switch on control panel. The READY lamp should go on. Control of the MTD is now turned over to the computer, and no further action is necessary.

NOTE:

START switch can be depressed immediately after LOAD/RWD switch. It is not necessary to wait for tape to be threaded and loaded prior to pressing START.

e. To regain local control of the MTD, depress the RESET switch.

SECTION IV
INSTALLATION

4.1 GENERAL

This section contains the instructions for unpacking, inspecting, installing and performing installation checks on the MTD.

4.2 UNPACKING AND INSPECTION INSTRUCTIONS

The MTD is packed in a shipping carton. To unpack the MTD, perform the following procedure:

a. Remove large plastic sleeve covering the MTD.

b. Remove cardboard shield taped to the front of the MTD.

c. Examine the MTD to insure that there is no visible evidence of damage which may have occurred during shipment. If any damage is apparent, report it immediately to the appropriate authority.

d. Unlatch and swing out MTD front casting frame and insure that all printed circuits boards are fully inserted.

e. Check input voltage source at site and insure that power supply transformer (T1) jumpers are installed accordingly. Refer to Table 4-1 for T1 jumper connections.

Table 4-1. Power Supply Transformer (T1) Jumpers

Required Input Voltage	Input Terminals	Terminals Jumpered
115 volts	1 and 2	1 to 3, 2 to 6
208 volts	1 and 4	2 to 3
220 volts	1 and 5	2 to 3
230 volts	1 and 6	2 to 3

4.3 INSTALLATION PROCEDURE

The MTD may be mounted in a standard 19-inch rack. After securing the MTD to the rack, electrical connections are made via the two data connectors J23 and J24, and the power connector J21, located at the rear of the unit as shown below in Figure 4-1.

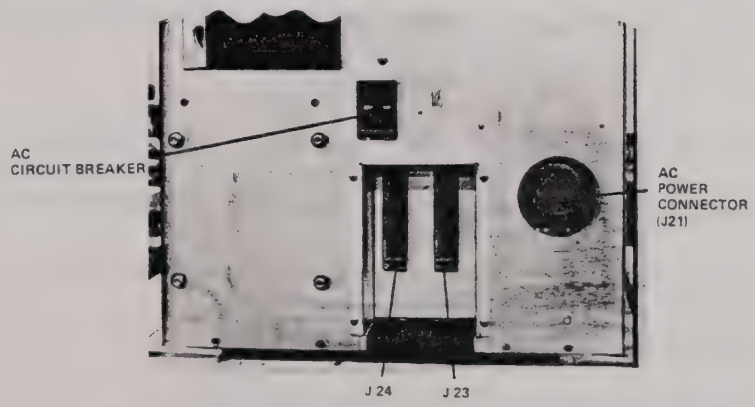


Figure 4-1. Rear View of MTD showing J23 and J24

4.4 CHECKOUT PROCEDURES (Refer to Section 3 OPERATION for details on operational procedures)

After completing the installation procedure as contained in paragraph 4.3, the following checkout procedure should be performed to determine if the MTD is operating properly.

4.4.1 TEST EQUIPMENT REQUIRED

The test equipment required to perform the checkout procedure is listed in Table 4-2.

Table 4-2. Checkout Test Equipment

Item	Description
Oscilloscope or Digital Voltmeter	Tektronix Model 535, or equivalent
Small hand tools	
Master Skew Tape	MDS P/N 801003602
Speed Indicators	Jacquets No. 2301 and 2302 or equivalent
Vacuum gauge	0-30 in. water
Pressure gauge	0.30 in. water
Meter	Simpson Model 260, or equivalent
Reel of Magnetic Tape (10-1/2 inches - 2400 ft.)	
Tape Cartridge	If Easy Load I Feature is installed.

4.4.2 LOAD OPERATION TESTS

a. Install 10-1/2-inch reel of tape on supply reel; place edge into the threading load chute (Figure 1-3).

b. Close dust cover.

c. Place power switch to ON position.

d. Depress LOAD/RWD switch.

NOTE:

Transport loads tape automatically and comes to rest at load point with BOT lamp on.

e. If unit does not load properly, check these items:

(1) Open vacuum column cover door. Check that vacuum column lamps are on.

(2) Check that there are no obstructions in the columns or near the read/write head assembly.

(3) Insure that the supply reel hub is in the locked position (lever flush with housing).

(4) Insure that edge of tape is cut clean with no sharp edges.

(5) If unit still does not load, refer to electrical checks below.

4.4.3 ELECTRICAL CHECKS

1. Check all fuses for a tight fit and continuity of all connections to Power Supply (A1), Regulator (A2) and Servo Capstan (A3) boards.

2. Utilizing local control, via the switches on the transport logic board (P52), verify and align (if necessary) the following as outlined in Section 6 of this manual:

   a. Pneumatic System – steps 6.2.0 thru 6.2.7.

   b. Sensor System – steps 6.3.0 thru 6.3.7.

   c. Servo System – steps 6.4.0 thru 6.4.8.

   d. Read/Write System – steps 6.5.0 thru 6.5.7.

4.4.4 COMPUTER ON-LINE CHECKS

a. With a certified good tape, load tape into the MTD, and press START switch on the control panel. Note that READY lamp lights. Unit is now ready for computer operation.

b. Check for writing all ONES in desired density (PE or NRZ).

c. Check for reading of prerecorded all ONES tape for both forward and reverse. If an excessive error rate is noticed, clean head or re-check the read/write adjustments.

d. Check write and read operation using random data. If random data check is satisfactory, the MTD is ready for diagnostic testing and normal data transfer operations.

SECTION V

PREVENTIVE MAINTENANCE AND REPLACEMENT

5.1 GENERAL

This section provides periodic preventive maintenance, and replacement data procedures required to effectively maintain the MTD.

5.2 TOOLS AND TEST EQUIPMENT

The following tools and test equipment (or their equivalent) are required to perform the maintenance procedures outlined in this manual.

5.2.1 METERS

a. Multimeter – Simpson 260 (or equivalent)

or

b. Digital Multimeter

5.2.2 GAUGES

a. Pressure Gauge (0-10 P.S.I.) MDS P/N 902001703

b. Vacuum Gauge (0-30 Inches of Water) MDS P/N 902001702

c. Pressure Gauge (0-30 Inches of Water) MDS P/N 902001701

5.2.3 OSCILLOSCOPE

a. Tektronics 535 (or equivalent)

5.2.4 SPECIAL TOOLS

a. Capstan Setting Gauge (MDS P/N 956013901)

b. Tape Cleaner Alignment Tool (MDS P/N 956013401)

5.2.5 HAND TACHOMETERS (Optional)

a. Jacquet 2301 or equivalent

b. Jacquet 2302 or equivalent

5.3 PREVENTIVE MAINTENANCE

Preventive maintenance for the MTD consists of scheduled periodic cleaning, lubrication, and replacement of wearing parts. (Refer to Table 5-1.) This schedule, when followed, will insure reliable equipment operation as well as a minimum of down-time for the MTD.

Table 5-1. Preventive Maintenance Schedule

	Every 8 Hours	Weekly	Monthly	Quarterly	Yearly
Clean tape path	X				
Clean outside surfaces of MTD		X			
Clean tape cleaner			X		
Clean air bearings			X		
Clean capstan motor Vent screen			X		
General lubrication				X	
Replace pneumatic filters					X
Inspect tape cleaner for wear					X
General inspection			X		
Electrical alignment checks				X	

5.3.2 DAILY PROCEDURES

After every eight hours of use, the tape transport and capstan must be cleaned as follows:

a. Unload tape from unit using standard unloading procedures.

b. Clean read/write heads, erase head, and tape cleaner blade with a lint-free cloth moistened with trichlorethane cleaner.

c. Clean tape guides (Figure 5-1), threading channels, air bearings, vacuum columns, and vacuum column door glass with a lint-free cloth moistened with trichlorethane. A small brush may be used to remove oxide buildups.

d. Tape residue buildup in vacuum columns, if not removable with trichlorethane, may be removed with a lint-free cloth moistened with soapy water.

CAUTION

WHEN CLEANING THE CAPSTAN, DO NOT TOUCH THE RUBBER TAPE DRIVING SURFACE WITH BARE HANDS AS MOISTURE OR OIL ON THE DRIVING SURFACE MAY SERIOUSLY AFFECT THE TAPE DRIVING CHARACTERISTICS OF THE CAPSTAN. DO NOT USE ALCOHOL TO CLEAN CAPSTAN.

e. Using a lint-free cloth and finger, rotate capstan while lightly wiping rubber surface of capstan with a lint-free cloth moistened with trichlorethane.

f. Wipe capstan surface dry using a lint-free cloth.

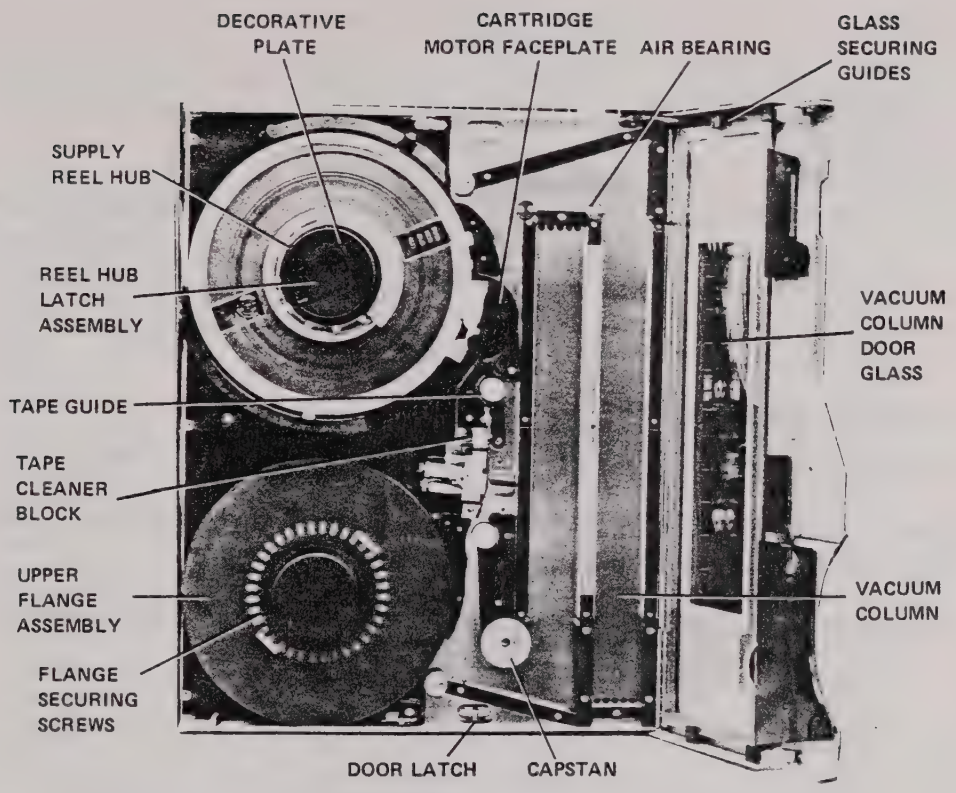


Figure 5-1. Tape Transport Area

5.3.3 WEEKLY PROCEDURES

In addition to the daily cleaning procedures, at weekly intervals clean all other MTD surfaces such as supply reel hub expansion ring, the inside surfaces, the outside surfaces, control panel, etc., as follows:

a. Using a clean lint-free cloth moistened with trichlorethane, clean the reel hubs and all inside surfaces of the MTD.

b. Using "Windex" or an equivalent, clean the inside of the dust cover, the outside surfaces of the MTD, and the control panel. Exercise care to insure that spray does not touch any tape contact surfaces.

5.3.4 MONTHLY PROCEDURES

Every month, the tape cleaner block must be cleaned. Cleaning the tape cleaner block is performed by first disassembling the tape cleaner block as shown in Figure 5-2, and then flushing with trichlorethane. Reassemble the tape cleaner block when finished.

CAUTION

DO NOT LOOSEN THE TAPE CLEANER ASSY. MOUNTING SCREW AS REALIGNMENT WILL BE NECESSARY.

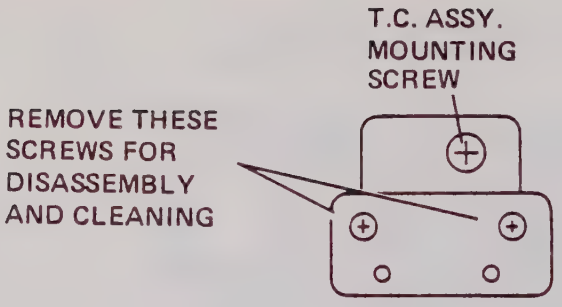


Figure 5-2. Tape Cleaner Assembly

Figure 5-2. Tape Cleaner Assembly

5.3.5 QUARTERLY PROCEDURES

Every three months, the procedures in the following paragraphs must be performed.

a. General Lubrication. Lubricate cam surface of supply reel hub (Figure 5-1) latch assembly using Type G Molykote, or equivalent.

b. Electrical Checks. The following items should be checked for possible realignment:

Read amplitude
Erasure
Skew
Capstan speeds
Capstan start/stop time
EOT/BOT sensitivity

5.3.6 ANNUAL PROCEDURES

Every 12 months, the procedures contained in the following paragraphs should be performed.

a. Inspection. Inspect all mechanical parts such as door hinges and latches for obvious signs of wear. Check condition and security of all mounting hardware.

b. Reel Latch Lubrication. To lubricate the reel latch, perform the following procedure:

(1) Pry off decorative plate with screwdriver.

(2) Apply Type G Molykote to cam surface and to detent spinner.

(3) Reinstall decorative plate.

c. Parts Replacement. The following items should be inspected and replaced if necessary:

(1) Pneumatic system filters (MDS P/N 808001603)

(2) Tape cleaner assembly (MDS P/N 950063701)

(3) Hub precision band (rubber that hold reel on hub when in lock position) MDS P/N 950376601.

5.4 TROUBLESHOOTING DATA

To facilitate troubleshooting, the maintenance technician should become thoroughly familiar with the MTD functional circuits as described in Section 2. Once familiar with the functional circuits, malfunctions can be isolated to a replaceable part. An alphabetical list of MTD signals which have readily accessible test points is provided in Table 5-2. In addition, reference should also be made to the schematic diagrams.

Table 5-2. Test Point List

Mnemonic/Test Point	Signal	Location
–BOT	–BOT SIG	LC (P52)
BOTA	BOT SENS COL	LC (P52)
BTR	CUST BOT RPY	LR/LD (P58)
–BTS	–BROKEN TAPE SIG	LC (P52)
CDV	CAPSTAN DR V	LC (P52)
CNTR	LOAD CNTR 1	LC (P52)
–CVAC	–COLUMN VACUUM	LC (P52)
DA1 thru DA9	Differential Amplifier 1 thru 9	RA (P51)
D200	200 Bpi Density	AC (P57)
D556	556 Bpi Density	AC (P57)
D800	800 Bpi Density	AC (P57)
–EOT	–EOT SIG	LC (P52)
–EOTA	EOT SENS COL	LC (P52)
–FWDC	–FWD CMD	AC (P57)
–IRDY	–INTL RDY STAT	LC (P52)
–IWCL		LC (P52)
LA1 thru LA9	Linear Amplifier 1 thru 9	RA (P57)
LOAD	LOAD	LC (P52)
LSPD	Low Speed Capstan Signal	LC (P52)
–LTP	–LOW TAPE SIG	LC (P52)
LTPA	LTP SENS COL	LC (P52)
–MAS	–MAS RESET	LC (P52)
NRZ	NRZ STAT	AC (P57)
–NUL	–SERVO AT NULL	LC (P52)
–RCL	–RD CLK	AC (P57)
–RCK	–RD CLK (OUTPUT)	LR/LD (P58)
RDY	CUST RDY	
–REV	–REV LATCH (IC518)-6)	AC (P57)
REVC	–REV CMD	AC (P57)
–REW M	–REW MEM	LC (P52)
RRS	CUST RD STAT	LR/LD (P58)
–RUN	–RUN	LC (P52)
–RWHD	–H SPEED REEL SIG	LC (P52)
–RWHM	–H SPEED MEM	LC (P52)
RDD1 thru RDD9	RD DATA DELAY 1 thru 9	AC (P57)
–RD1 thru RD9	–RD DATA OUT 1 thru 9	LR/LD (P58)
RMP	RAMP	LC (P52)
RWRP		LC (P52)
SMDV	SUPPLY MOTOR DRIVE CONTROL	A3

Table 5-2. Test Point List (Cont'd.)

Mnemonic/Test Point	Signal	Location
SNS	SUP TNK NULL SENS	A3
–SRCL	–Set Read Clock	AC (P57)
SVO EN	NORM SERVO ENABLE	LC (P52)
TFB	TACH FDBK	LC (P52)
+THS	+THRES	RA (P51)
–THS	–THRES	RA (P51)
TMDV	TAKE-UP MOTOR DRIVE CONTROL	A3
TNS	TU TNK NULL SENS	A3
TOR	TAPE ON REEL	LC (P52)
TTPA	TTP SENS COL	LC (P52)
–TVD	–TRANSFER VALVE DR	LC (P52)
–VMD	–VAC MTR DR	LC (P52)
WCLK	WCLK	LC (P52)
WF1 thru WF9	WR DATA 1 THRU 9 DELAYED	WA (P53)
WH1 thru WH9	WR HD 1 thru 9 LO	WA (P53)
WRS	WR STAT	AC (P51)

5.5 REPLACEMENT PROCEDURES

The following paragraphs provide the procedures for removing and replacing electrical, mechanical, and electromechanical maintenance parts. Electrical and electronic parts are contained, for the most part, on printed circuit boards located in the electronics module on the back of the MTD front casting. The procedures for removing electrical and electronic parts as well as attaching hardware, unplugging of connectors, unsoldering and tagging leads, disconnecting terminal board connections, etc., are standard and are not covered in this section.

5.6 LOCATING COMPONENTS ON PRINTED CIRCUIT BOARDS

All printed circuit boards in the MTD use an identical grid system, Figure 5-3, which allows for ease of location of circuit elements.

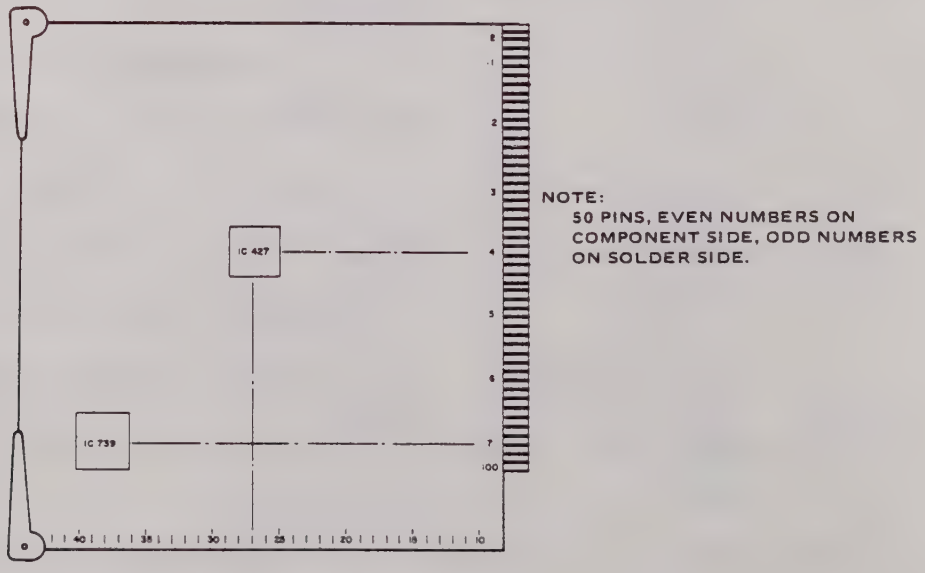


Figure 5-3 Printed Circuit Board Grid System

The printed circuit board is divided vertically along the connector edge, into 7- or more sections or grids. These grid numbers are near the connector edge of the board. In addition, the board is divided horizontally from the connector edge to the front (handle) edge, into grids numbered from 10 to 40. Referring to a typical schematic diagram, a particular logic gate may be designated IC839. This designation means that the integrated circuit chip in which this particular gate is located is mounted at, or near, the point where grid 8 and grid 39 intersect, as shown in Figure 5-3. In a like manner, IC427 is located at the intersection of grids 4 and 27 as illustrated.

5.7 TYPES OF CIRCUIT BOARDS

There are two types of circuit boards in the MTD, those located in the electronic card cage chassis, Figure 5-4, and those located on the inside rear of the chassis, Figure 5-5. The removal procedures for these boards are provided in the following paragraphs.

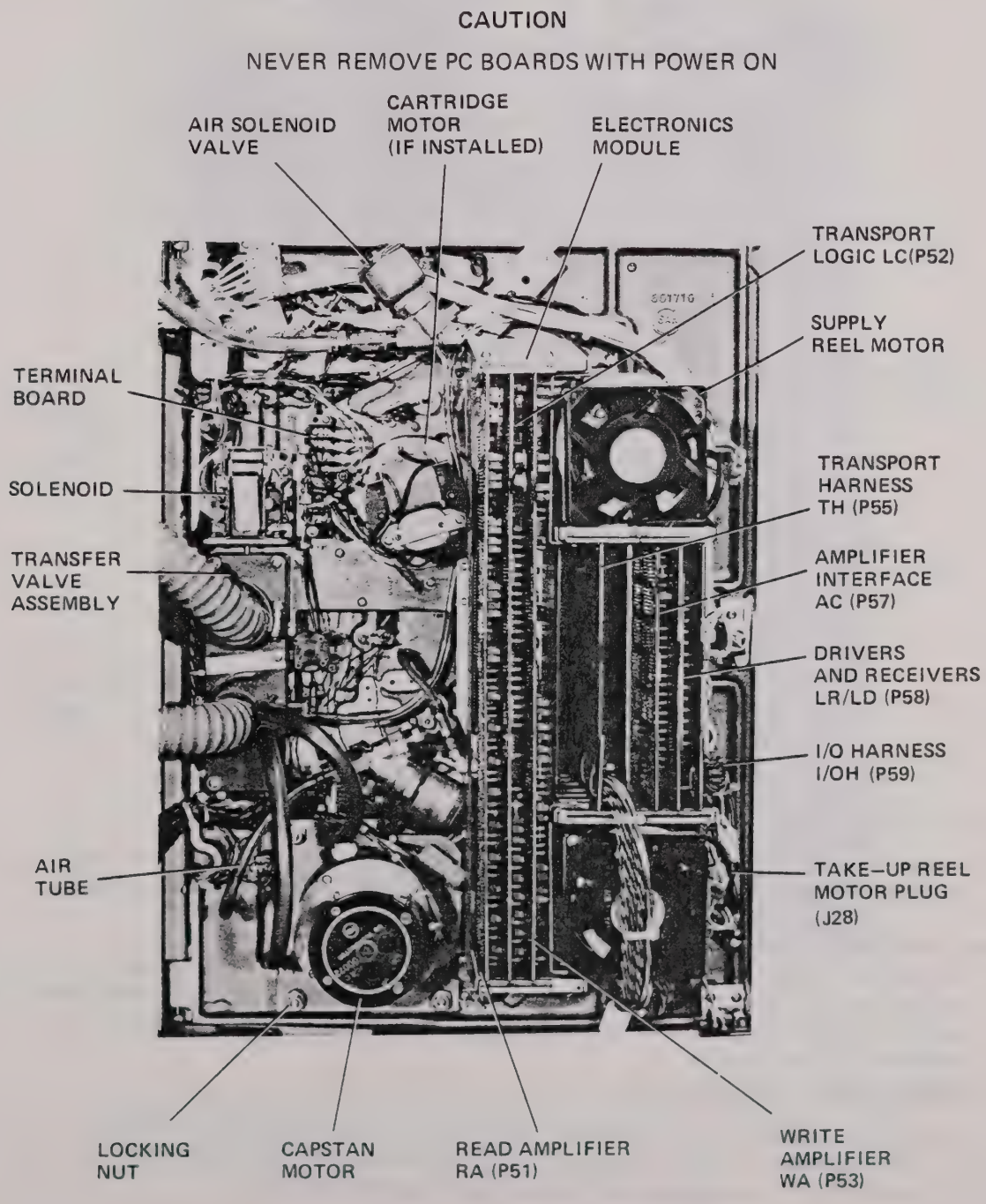


Figure 5-4. MTD Front Casting, Rear View

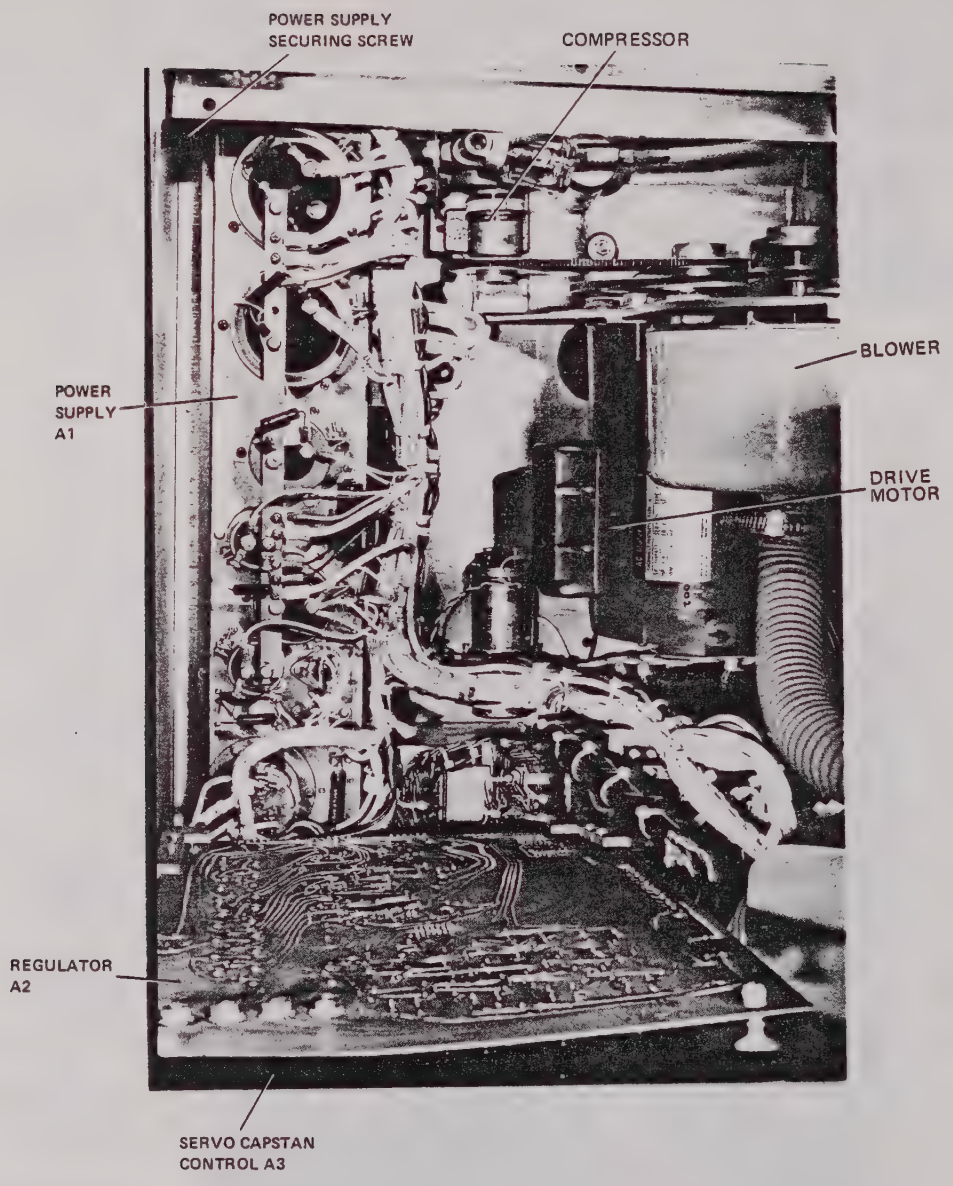


Figure 5-5. Chassis Interior, PC Boards Swung Down

Cards In The Electronics Module (Figure 5-4)

To remove these printed circuit boards, pull out the center of the retaining clip until both halves of retaining clip are in horizontal position. Slide printed circuit board out of card cage chassis.

Cards Inside Rear of Chassis (Figure 5-5)

To remove printed circuit board A3, loosen release clips. Then fold card down and remove four securing screws, Figure 5-6, and slide board A3 out of guide. To remove printed circuit board A2, loosen clips and pull card A3 down, exposing board A2. Loosen release clips, four securing screws, and slide board A2 out of guide.

5.8 POWER SUPPLY A1(Figure 5-5)

To remove power supply A1 components, remove the four self-tapping screws and associated washers which secure the power supply bracket to the chassis. Capacitors can now be removed through the rear of the bracket, and all other components can be removed using standard procedures.

5.9 COOLING FAN

To remove cooling fans, tag and remove all leads. Remove four screws, Figure 5-6, and associated washers securing fan to bottom of chassis.

5.10 MAIN TRANSFORMER

To remove main transformer, Figure 5-6, remove all leads to transformer. Then remove four knurled, Allen-head bolts and associated washers which secure transformer to chassis, and remove transformer.

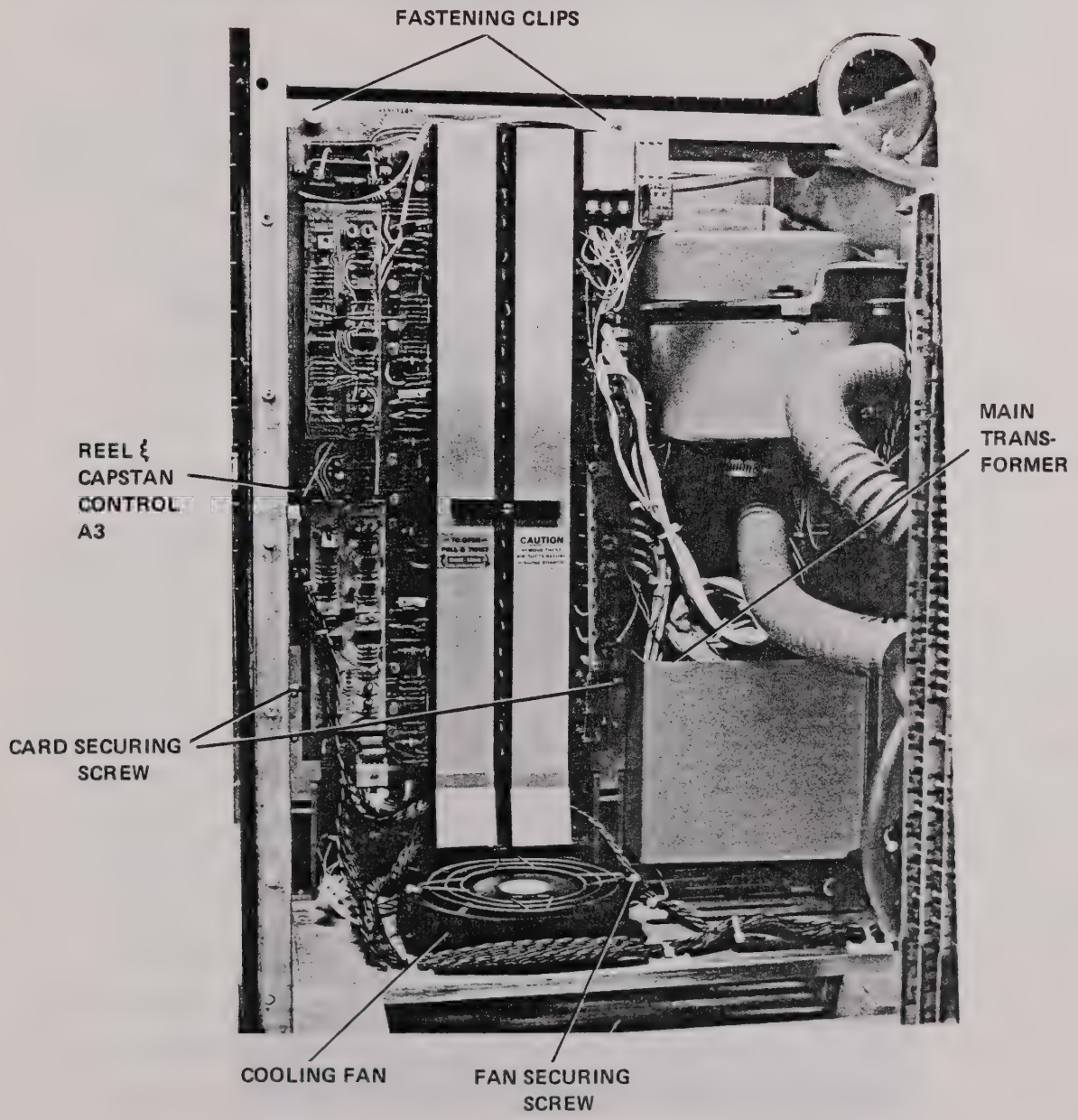


Figure 5-6. Chassis Interior, Location of Components and Securing Hardware

5.11 PNEUMATIC SUPPLY ASSEMBLY (Figure 5-7)

NOTE:
It is advisable to remove the A1, A2 and A3 PWB's before removing the pneumatic assembly.

A. Vacuum Drive Motor

1. Loosen hose clamps and remove hoses from blower and compressor.

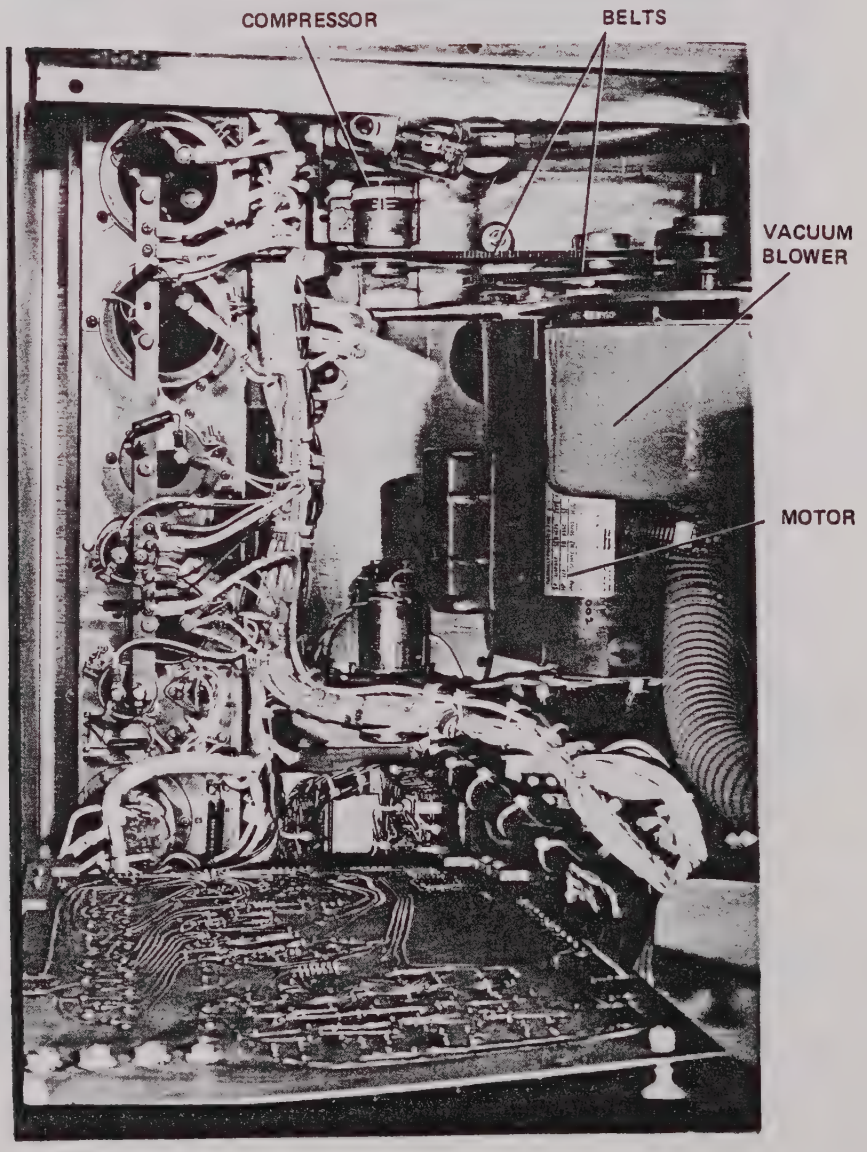


Figure 5-7. Pneumatic Supply Assembly

2. Remove the blower

3. Remove the pneumatic supply assembly by removing the three bolts and nuts which secure the assembly to the Tape Drive chassis.

4. With the assembly removed, loosen the two screws that hold the compressor to the bracket and slip off the drive belt.

5. Remove the four bolts that hold the drive motor to the casting.

B. BLOWER

1. Loosen hose clamps and remove hoses from blower.

2. Remove the three bolts that secure the blower to the casting.

3. Slip the drive belt up off the pulley.

C. COMPRESSOR

1. Remove glass jars attached to compressor inlet and outlet.

2. Loosen hose clamps and remove hose from compressor outlet.

3. Loosen nuts (with nut driver) that secure compressor to casting.

4. Hold bolt with fingers while removing nuts and washers.

5.12 CONTROL PANEL

To remove the control panel components, first remove the control panel, as follows:

a. Open the dust cover and front door of the MTD. (See Figure 5-8).

b. Unplug P12 and P13 as shown in Figure 5-9.

c. Remove bottom two screws and guides which secure glass vacuum column cover to front door, and remove glass vacuum column cover.

d. Loosen two screws that hold cable guides, as shown in Figure 5-9. Remove one. Tilt cable guide up and tighten other screw to hold it in that position. Remove plug from rear of control panel.

e. Remove four screws and associated washers which secure control panel to front door, and remove control panel.

5.13 CAPSTAN MOTOR

To remove the capstan motor, Figure 5-9, proceed as follows:

a. From rear of MTD, unplug connector (P24) to capstan motor.

b. Remove cooling air tubes from motor.

c. Remove three locking nuts securing motor to frame.

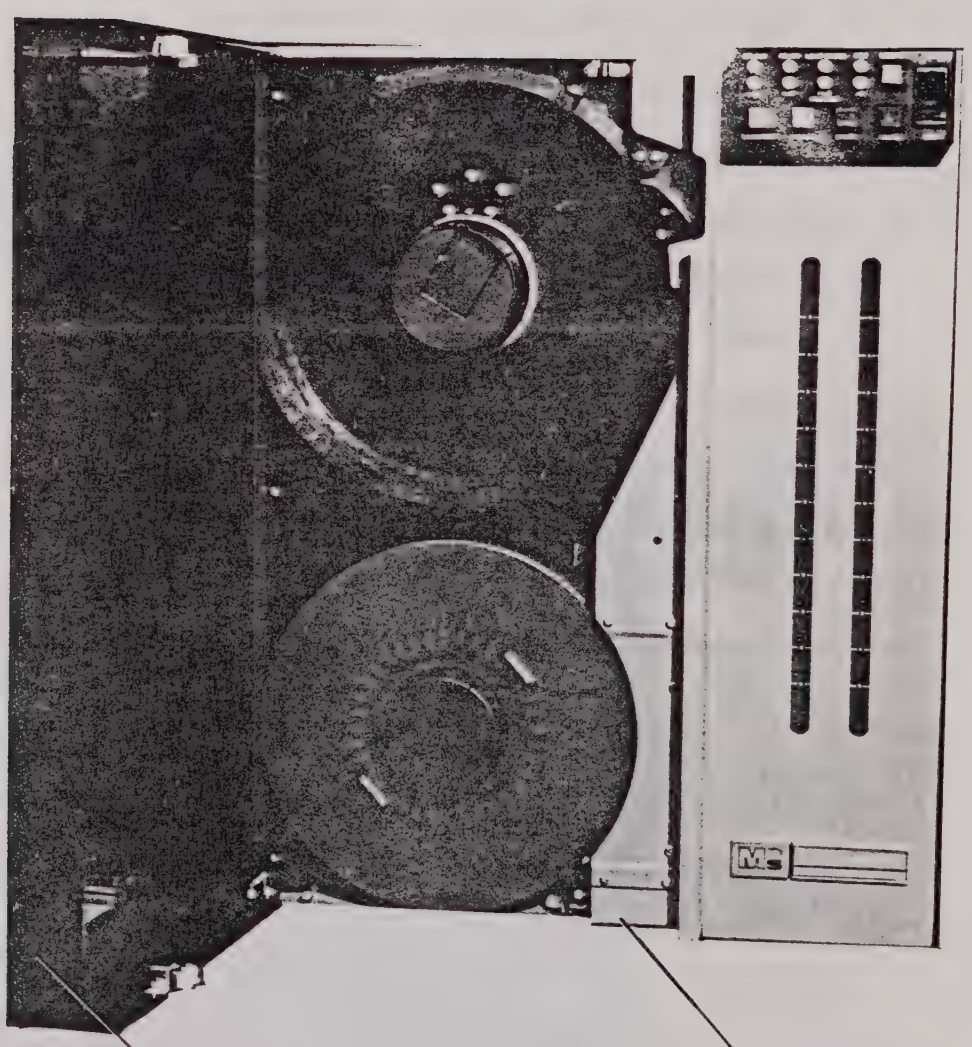


Figure 5-8. MTD, Dust Cover Open

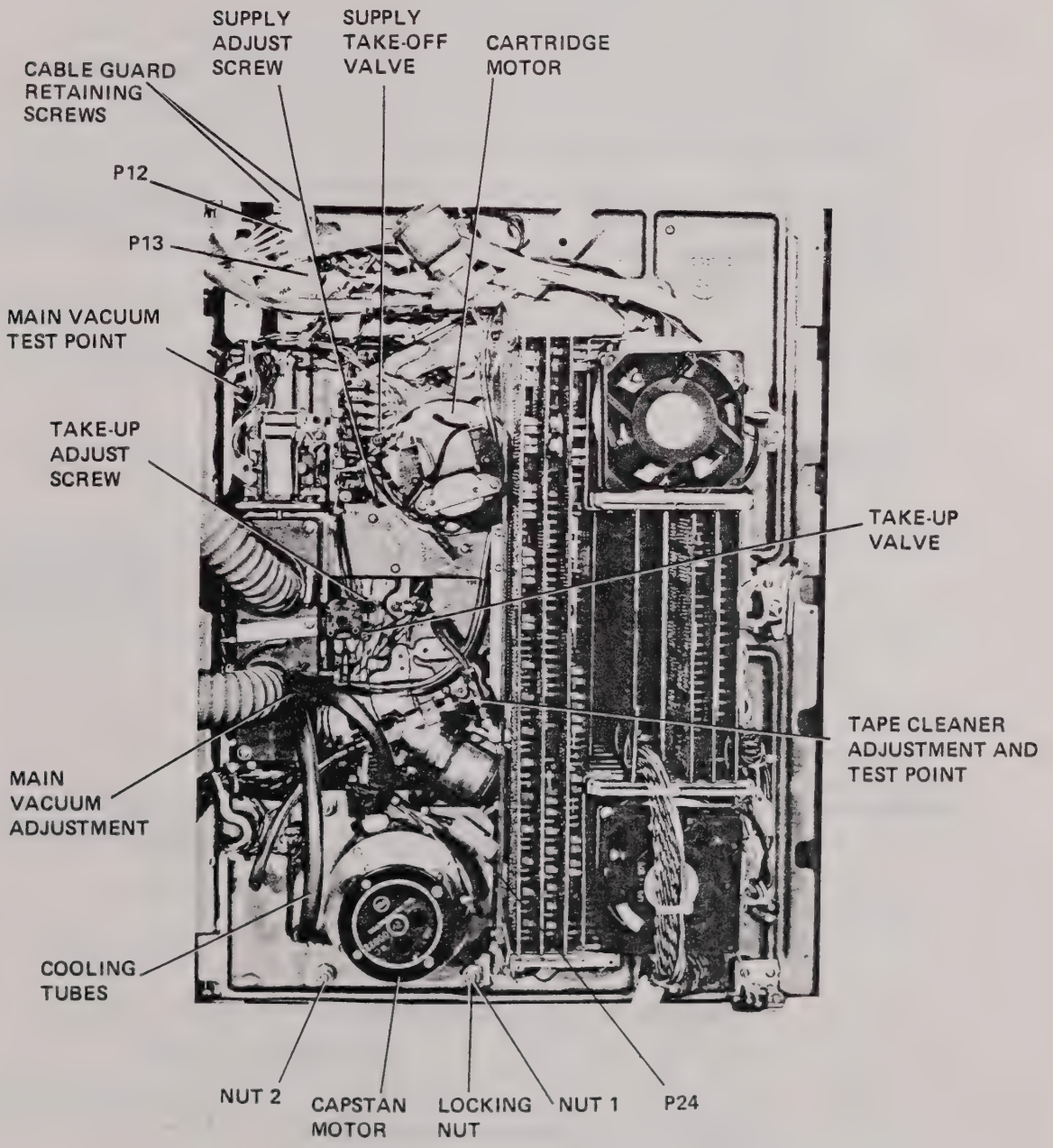


Figure 5-9. Rear Panel Details

CAUTION

CAPSTAN IS FRAGILE; AVOID TILTING THE MOTOR OR SCRAPING CAPSTAN ON FRAME WHEN REMOVING.

d. Remove capstan motor from the rear of MTD.

To Install A Capstan Motor

a. Insert capstan motor assy through hole in front casting using *extreme* caution so as not to scrape capstan surface on casting.

b. Loosely secure assembly with three locking nuts.

c. It is very important that the capstan have the proper clearance between it and the hole in the front casting of the MTD. The proper clearance is .005 to .009 in. as shown in Figure 5-10A. To obtain this, slide the capstan into a position where the proper clearance is obtained and tighten the three locking nuts to hold it there.

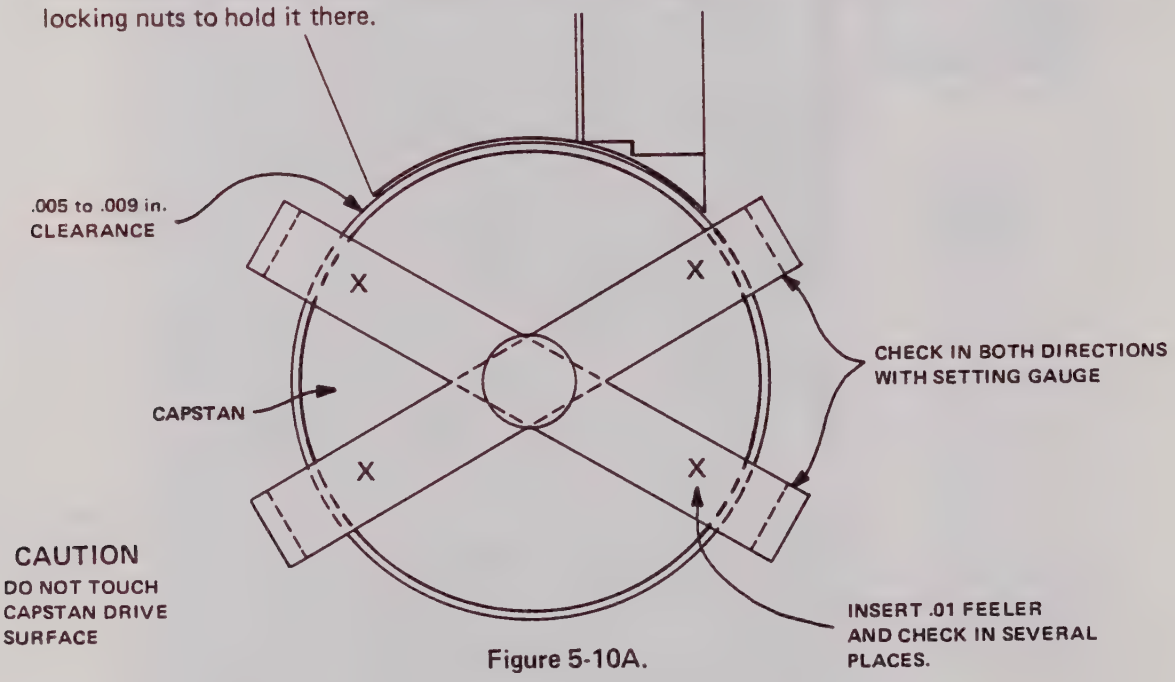


Figure 5-10A.

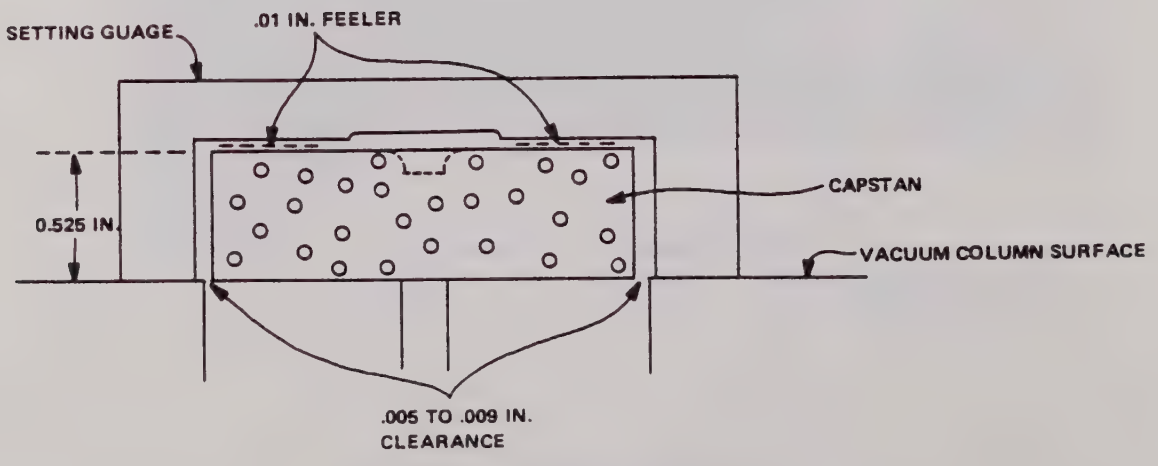


Figure 5-10B. Capstan Adjustment

d. The front surface of the capstan must be o.525 ±001 in. from the vacuum column surface. This adjustment is obtained by loosening the locking nuts and turning the three adjustment collars using the Capstan Setting Gauge (MDS P/N 956013901) as a guide (see Figure 5-10B). A .01 in. shim should be inserted between the front capstan surface and the gauge.

NOTE

This alignment is critical and must be set to tolerance so that capstan is perfectly spaced in all directions. Therefore, several attempts may be necessary to obtain these tolerances.

e. Once the mechanical alignment is completed, connect J24 and refer to the Capstan Tracking Alignment in Section 6 of this manual and insure that tracking is adjusted properly.

5.14 SUPPLY REEL MOTOR

To remove a supply reel motor:

a. Unplug J29 (Power Connector for Supply Reel Motor).

b. Pry off the decorative plate which covers the hub. This will expose the three screws that secure the outer hub assembly.

c. Remove the three screws and the outer hub assembly. This will expose three retaining rings that secure the plastic piston.

d. Remove the three rings and the plastic piston. This will expose a large nut (1-1/8") that hold the inner hub assembly to the Supply Reel Motor shaft.

e. Make a mark, with pencil or other such marking device, on the four bosses at the rear of the casting that supports the reel motor to show where the reel motor assembly is mounted.

NOTE:

This is done to facilitate faster alignment of the replacement motor when installing.

f. Remove the large nut, using a shallow wall socket (1-1/8"), and remove the inner hub assembly. This will expose four screws which are used to secure the reel motor to the frame of the MTD.

g. Remove the four screws which hold the reel motor against casting, and carefully remove the motor.

To Install a Supply Reel Motor:

a. Insert reel motor from rear of front casting, and install four securing screws.

NOTE:

Line motor up with marks made on bosses in step e above before tightening screws.

b. Install the inner hub assembly using large nut (1-1/8") to hold in place – DO NOT TIGHTEN NUT FIRMLY.

c. Set the inner hub position on shaft by using a blank reel pressed against the back of the hub assembly. Check the spacing from the front of the rear surface of this reel to the vacuum column surface (use feeler gauge and straight edge as shown in Figure 5-12 for this). The distance should be .030 in.

NOTE:

Rotate reel and check in several places for uniformity.

When correct distance is obtained, tighten the large nut to hold the inner hub assembly in place.

d. Before installing the plastic piston, remove the rubber precision band that holds the 12 tension segments and remove the 12 segments.

e. Install the piston, using the three retaining rings to hold in place.

f. Reinstall the 12 tension segments, slipping them under the tension spring and insuring that they rest in the groove on the outer spacer ring.

g. Reinstall the rubber precision band carefully, insuring that is seated properly.

h. Reinstall the outer hub assembly using the three allen screws to hold in place – do not overtighten, as the threads can be stripped easily.

i. Replace the decorative plate.

j. Reconnect J29.

5.15 TAKE-UP REEL MOTOR

To remove a Take-Up Reel Motor:

a. Uncouple J28 (Reel motor power cable).

b. Remove the six screws that hold the outer flange assembly to the hub and remove the outer flange assembly.

c. Mark the position of the reel motor on the bosses that support the reel motor on the back of the casting with a pencil or other suitable marking device.

NOTE:

This is done to facilitate faster installation of the replacement reel motor.

d. Remove the large nut (using a 1-1/8" socket) and remove the hub assembly. This will expose the four screws that hold the reel motor from the back of the casting.

e. Remove the four screws and carefully remove the reel motor from the back of the casting.

To Install a Take-Up Reel Motor:

a. Insert reel motor from rear of front casting and install four securing screws.

NOTE:

Line motor up with marks made on bosses in step c above before tightening screws.

b. Install hub assembly using large nut to hold in position. DO NOT TIGHTEN NUT FIRMLY.

c. Set the hub position by checking the distance between the front of the rear flange (B) of the Take-up Reel and the vacuum column surface (A) using a straight edge and feeler gauge as shown in Figure 5-12 below. The distance should be .030 in.

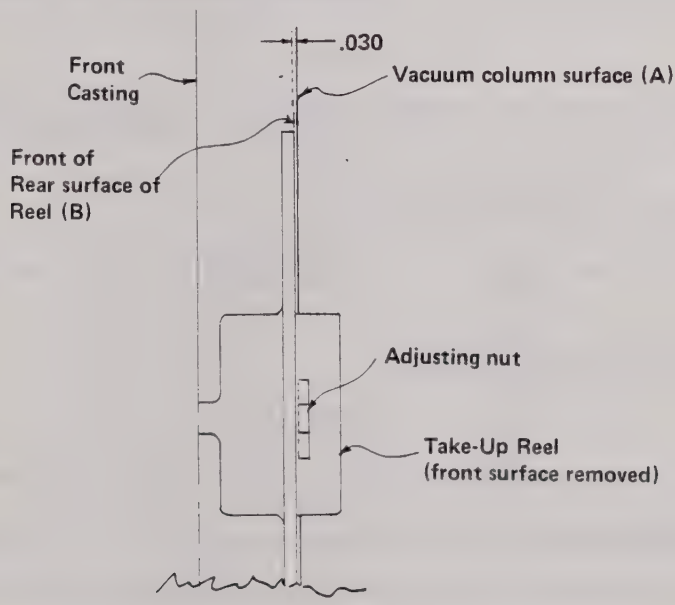


Figure 5-12. Take-Up Motor Clearance Adjustment

When the correct distance is obtained, tighten the large nut firmly to hold the hub assembly in place.

d. Install the outer flange assembly using six screws removed as in step b above.
NOTE: Be sure to line up reflective marker with openings in rear surface of reel.
e. Reconnect J28.

5.16 CARTRIDGE MOTOR

To remove the cartridge motor (if installed) Figure 5-9, proceed as follows:

a. On front of MTD, remove one Phillips-head screw which secures the faceplate, Figure 5-1, to the cartridge motor, and remove the faceplate.

b. From rear of frame, unplug connector and tag removed leads at the terminal board.

c. Remove three screws securing motor assembly to front panel and pull assembly back to remove.

d. Remove four screws that hold motor to collar and remove collar. Save collar and screws for reinstallation, which is the reverse of this procedure.

5.17 READ/WRITE HEAD ASSEMBLY

To remove the read/write head assembly, Figure 5-1, proceed as follows:

a. Remove three connectors from read/write and erase heads being careful not to pull connectors off logic module.

b. Remove ground wire from read cable to R/W hand assembly.

c. Remove two screws securing read/write head from rear of main panel.

d. Loosen azimuth adjustment (socket-head screw) located next to erase head.

NOTE:

Exercise care not to lose two spring washers on the azimuth adjustment socket-head screw between read/write head assembly and main panel.

e. Read/write head is now loose. Pull straight out.

f. Clean area (where read assembly is located) of all residue, with lint free cloth before attempting to reinstall.

g. Clean R/W mounting block of all residue.

NOTE:

Head assembly is pinned and needs no location alignment.

h. Install new read/write head in reverse order of removal.

i. Realign Tape Cleaner assembly per Section 6.5 of this manual.

j. Realign MTD for new read/write head using procedures for mechanical and electrical skew, read amplitude, and write compensation, as required, in Section 6 of this manual.

SECTION VI

ALIGNMENT PROCEDURE

6.1 POWER SUPPLY ADJUSTMENTS

A. Tools Required:

1. Multimeter (Simpson 240 or equivalent) or oscilloscope (Tektronix 535 or equivalent).
2. Alignment tool (Bourns Trimpot or equivalent)

B. Procedure:

1. Power down MTD by depressing ON/OFF switch in OFF direction.
2. Open MTD to gain access to internal electronics modules.
3. Remove heat chimneys from Reel and Capstan PCB (A3).
4. Unsnap fasteners holding Reel and Capstan PCB (A3) and slowly lower it to rest position, to expose the Regulator PCB (A2).
5. Depress 'Power ON'.
6. Adjust the voltages per Table 6-1 below:

Table 6-1. Power Supply Voltage Adjustments

Voltage	Connect Meter to Test Point	Adjust	Tolerance
+30V	+30	R627	+27 to +33 VDC
+12V	+12	R408	+11.4 to +12.6 VDC
+ 5V	+ 5	R418	+4.8 to +5.6 VDC
−6V	− 6	R523	−5.7 to −6.3 VDC
−12V	−12	R631	−11.4 to −12.6 VDC

7. Replace Reel and Capstan PCB (A3). Snap fasteners to hold in position.
8. Replace heat chimneys on Reel and Capstan PCB (A3).

6.2 PNEUMATIC SYSTEM

NOTE:

Before making any adjustments to the Pneumatic System, check the tension on both Blower and Compressor bolts. The vacuum blower tension should be checked at the middle of its span. No more than 1/4" ($\pm$1/16") of deflection should occur at this point using a two pound force. If adjustment is needed, loosen the three bolts that secure the blower in place and slide it towards or away from the drive motor as required.

The compressor belt tension should also be checked at the middle of its span, using a one pound force, to obtain a deflection of 1/8" (±1/16"). To adjust the tension, slide the compressor closer to or further away from the drive motor, loosening the two locking bolts on either side of the compressor assembly.

CAUTION

INSURE THAT COOLING PORTS ON CAPSTAN MOTOR ARE CLEARED BEFORE MAKING ANY ADJUSTMENTS.

6.2.1 MAIN VACUUM (29 ±2 in. water)

A. Tools Required:

1. Manometer or 0-30 inch gauge (1/4" I.D. tubing).

2. 2400 ft. scratch tape.

B. Procedure:

1. Power down MTD.

2. Remove plastic end cap over Main Vacuum Test Point (A). See Figure 6-1.

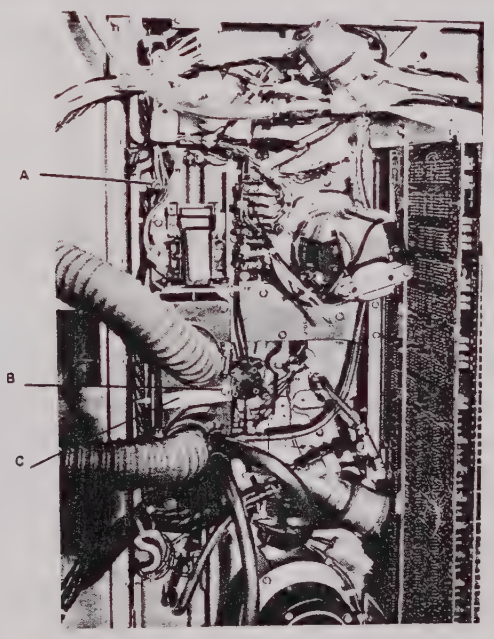


Figure 6-1. Main Vacuum Adjustments

3. Connect the hose from the top of the manometer, or gauge, to this test point.

4. Mount scratch tape on supply reel.

5. Apply power to MTD and load tape into tanks.

6. Measure vacuum at test point, after tape has loaded into loop boxes.

7. The vacuum should be at 29 ±2 inches of water. If it is not within this range, loosen screw (B) and adjust the vacuum adjusting plate (C), (See Figure 6-1), to obtain a reading within the range of 27-31 inches of water.

8. Unload tape and power down MTD.

9. Reinstall cap on Main Vacuum Test Point (A).

6.2.2 CAPSTAN COOLING VACUUM (12 + in. of water)

A. Tools Required:

1. Manometer or 0-30 inch gauge (3/8" I.D. tubing)

2. Plastic tubing T (3/8" I.D.) See Figure 6-3.

B. Procedure:

1. Power down MTD.

2. Remove one vacuum line from capstan fitting (D) on Transfer Valve Assembly (see Figure 6-2).

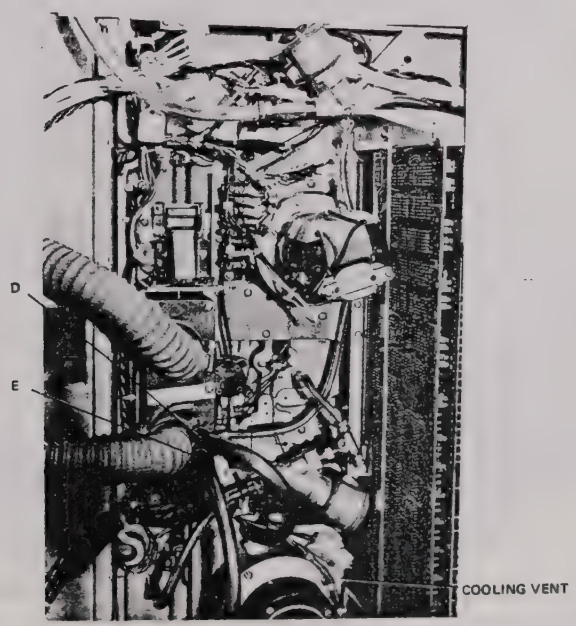


Figure 6-2. Capstan Cooling Check

3. Connect 'T' as shown in Figure 6-3.

Figure 6-3. Plastic Tubing 'T' Connections

4. Power up MTD.

5. If a reading is less than 12 inches of water, check for air leakage between capstan and transfer valve, (poor fittings, cracked hose etc.).

6. If vacuum is extremely high, check for restrictions (dirt, pinched hose etc.) in the capstan motor filter screen and vacuum line between capstan motor and transfer valve.

NOTE:

If a black plastic plate is on transfer valve (as in Figure 6-4), adjustment is possible. If it is not then disregard steps 7 thru 9.

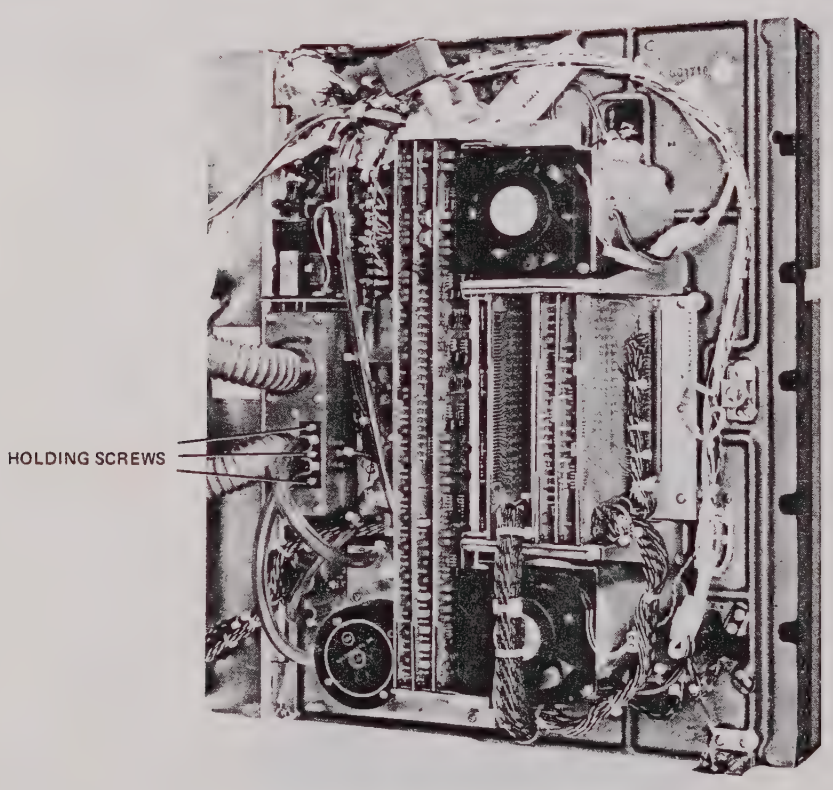


Figure 6-4. Capstan Cooling Adjustment (Earlier Models)

7. Loosen the three holding screws.

8. Slide back plastic plate left or right to obtain a reading of 12 inches of water on manometer or gauge.

9. Tighten the three holding screws.

10. Power down MTD.

11. Remove 'T' fitting from capstan hose D and perform same checks on capstan hose E.

6.2.3 TAPE CLEANER VACUUM (13 ±0.5 in. of water)

A. Tools Required:

1. Manometer or 0-30 inch gauge (5/32" I.D. tubing).
2. 7/16" Open-End wrench.
3. 7/16" Allen wrench.

B. Procedure:

1. Power down MTD.
2. Remove plastic cap over tape cleaner vacuum point (F) as shown in Figure 6-5 below:

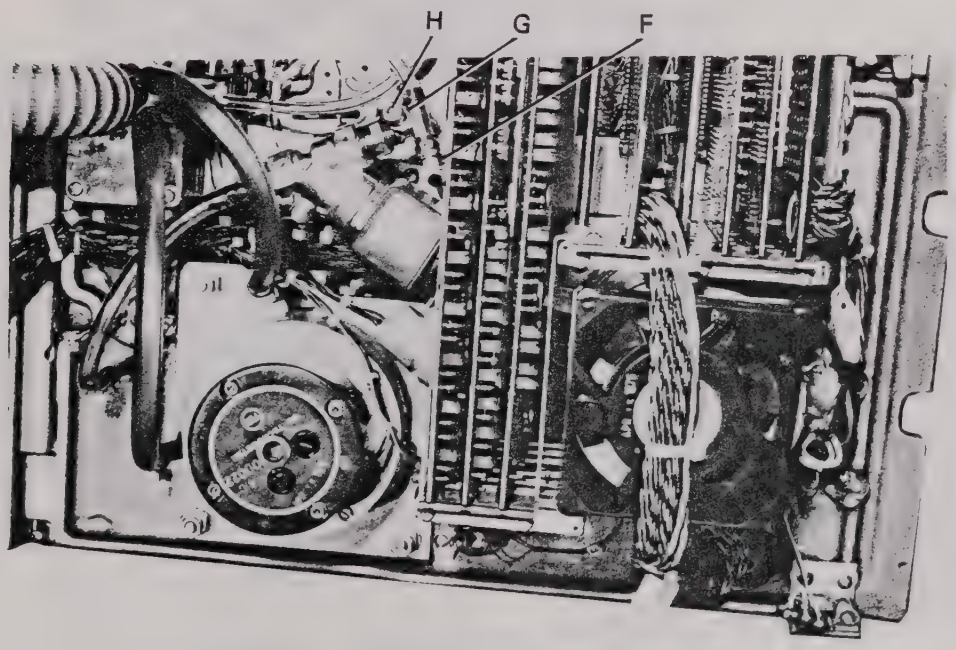


Figure 6-5. Tape Cleaner Vacuum Adjustment

3. Connect the hose from the top of the manometer to read point (F).
4. Loosen 7/16" nut (G).
5. Apply power to MTD and load tape into tanks.
6. Adjust 3/16" Allen screw (H) to obtain a reading of 13 ±1.5 inches of water on manometer or gauge. Tighten nut G.
7. Unload tape and power down MTD.
8. Remove manometer or gauge, and reinstall plastic cap over read point (F).

6.2.4 AIR BEARING PRESSURE (3.75- 4.25 PSI)

A. Tools Required:

1. Pressure gauge (0-10 PSI; 5/32" I.D. tubing).

B. Procedure:

1. Power down MTD.

2. Connect pressure gauge to read point (J) as shown in Figure 6-6 below.

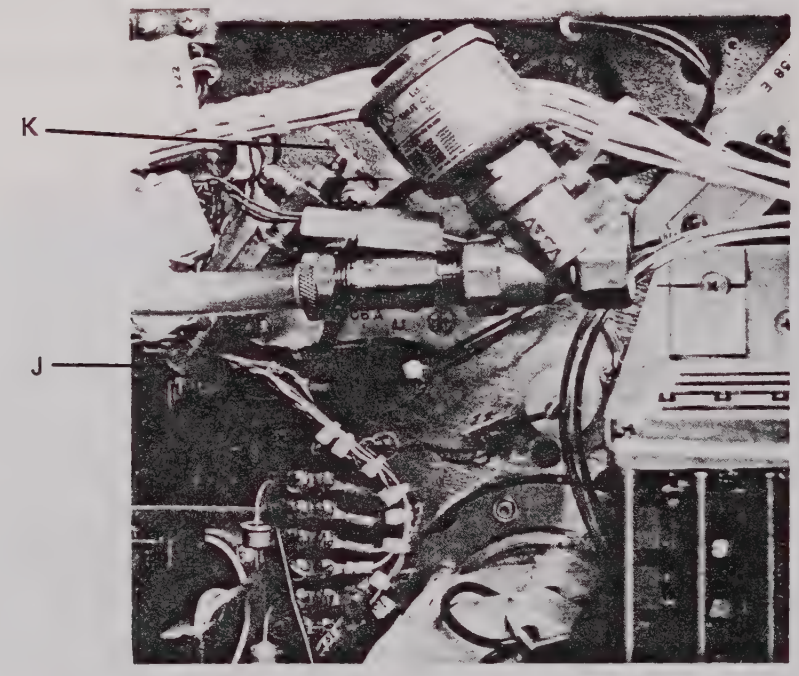


Figure 6-6. Air Bearing Pressure Adjustment

3. Power up MTD and load tape into tanks.

4. Press upward at read point (J) to obtain a reading on pressure gauge.

5. Adjust knob (K) to set pressure to 3.75 - 4.25 PSI.

6. Unload tape and power down MTD.

7. Disconnect pressure gauge from read point (J).

6.2.5 UPPER THREADING PRESSURE (4.5 ±0.5 in. of water)

A. Tools Required:

1. Manometer or 0-30 inch gauge (5/32" I.D. tubing).

2. Tape Cartridge (if drive has Easy Load I feature).

3. Long-thin-flat-bladed screwdriver.

B. Procedure:

1. Power down MTD.
2. Install tape cartridge in open position (disregard if drive does not have Easy Load I feature) Depress Cartridge switch if Easy Load I feature is not in MTD.
3. Unplug the take-up motor at J28 (See Figure 6-7).
4. Remove plastic cap from read point (L), see Figure 6-8 below.

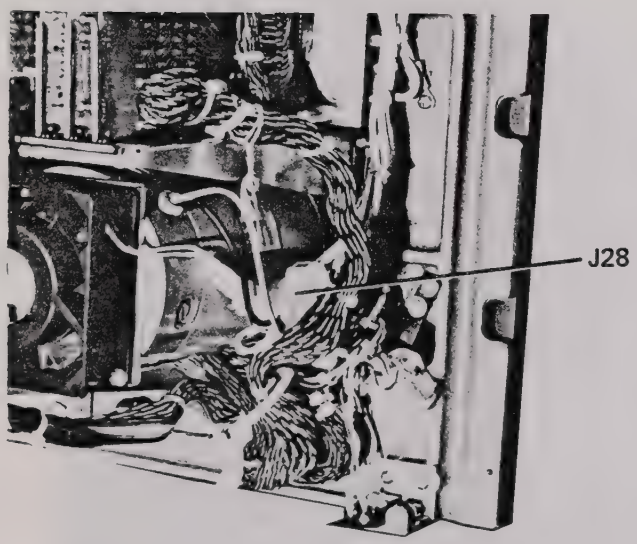


Figure 6-7. Take-Up Motor

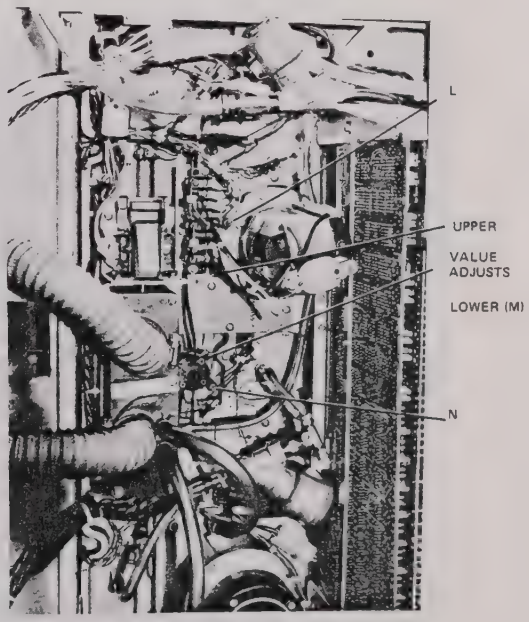


Figure 6-8. Threading Pressure Adjustments

5. Attach Manometer or gauge, to read point (L).
6. Apply power to MTD.
7. Depress RESET and LOAD switches on control panel.
8. Adjust Upper Thread Adjust Valve using a long thin flat bladed screw driver to obtain a reading of 4.5 ±0.5 inches of water on Manometer.
9. Power down MTD.

10. Reconnect take-up motor through plug J28 (See Figure 6-7).

11. Remove Tape Cartridge from drive (Disregard if Drive does not have Easy Load feature) or release Cartridge switch.

12. Replace plastic cap on read point (L).

6.2.6 LOWER THREADING PRESSURE (6.5 ±0.5 in. of water)

A. Tools Required:

1. Manometer or 0-30 in gauge (1/4" tubing).

2. Tape Cartridge (if drive has Easy-Load I feature).

3. Long-thin-flat-bladed screwdriver.

B. Procedure:

1. Power Down MTD.

2. Install Tape Cartridge in open position (disregard if Drive does not have Easy Load I feature) Depress Cartridge switch if Easy Load I feature is not in MTD.

3. Unplug the take-up motor at J28 (See Figure 6-7).

4. Remove plastic cap from read point (N) (See Figure 6-8 in Section 6.2.5 of this procedure).

5. Attach Manometer or gauge to Read Point (N).

6. Apply power to MTD.

7. Depress RESET and LOAD switches on Control Panel.

8. Adjust Lower Thread Adjust Valve (M) to obtain a reading of 6.5 ±0.5 inches of water on manometer, or gauge.

9. Power down MTD.

10. Reconnect take-up motor through plug J28 (See Figure 6-7).

11. Remove tape cartridge from drive — or release Cartridge switch.

12. Replace plastic cap in read point (N).

6.2.7 CARTRIDGE PRESSURE (18 ±1 in. of water) (Drives with Easy Load I feature only)

A. Tools Required:

1. Manometer or 0-30 in gauge.

2. 2-1/2" piece of 1/2" plastic tubing with 1/2" I.D. rubber grommet (See Figure 6-9).

Figure 6-9. Cartridge Pressure Adjustment Tool

B. Procedure:

1. Power down MTD.

2. Remove any tape cartridge that may be on drive.

3. Insert 1/2" plastic tubing, with grommet attached, into air hole read point (Q). See Figure 6-10 below.

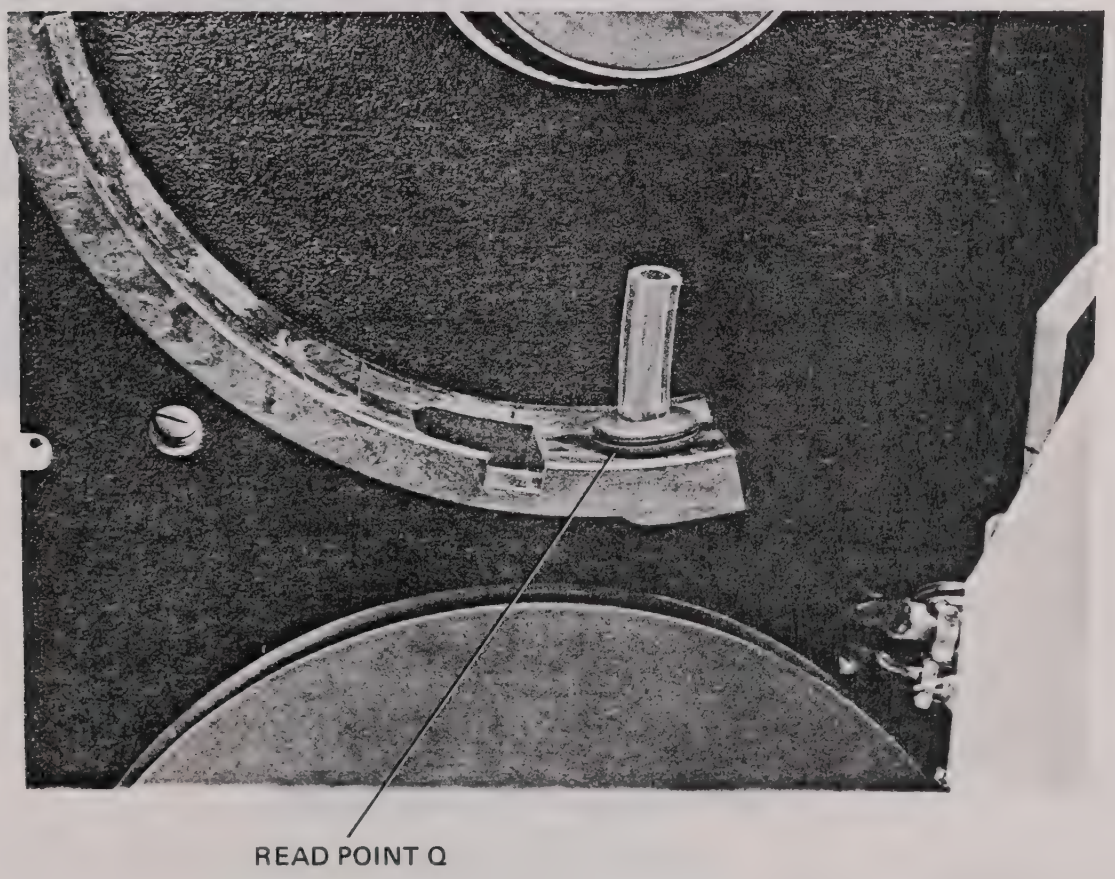


Figure 6-10. Cartridge Pressure Read Point

4. Connect Manometer or gauge, to 1/2 plastic tubing just installed in step 3 above.

5. Power up MTD.

6. Depress and hold Cartridge switch.

7. Adjust cartridge pressure to 18 ±1 inch of water by loosening screw (R) and sliding pressure plate (S) (See Figure 6-11 below).

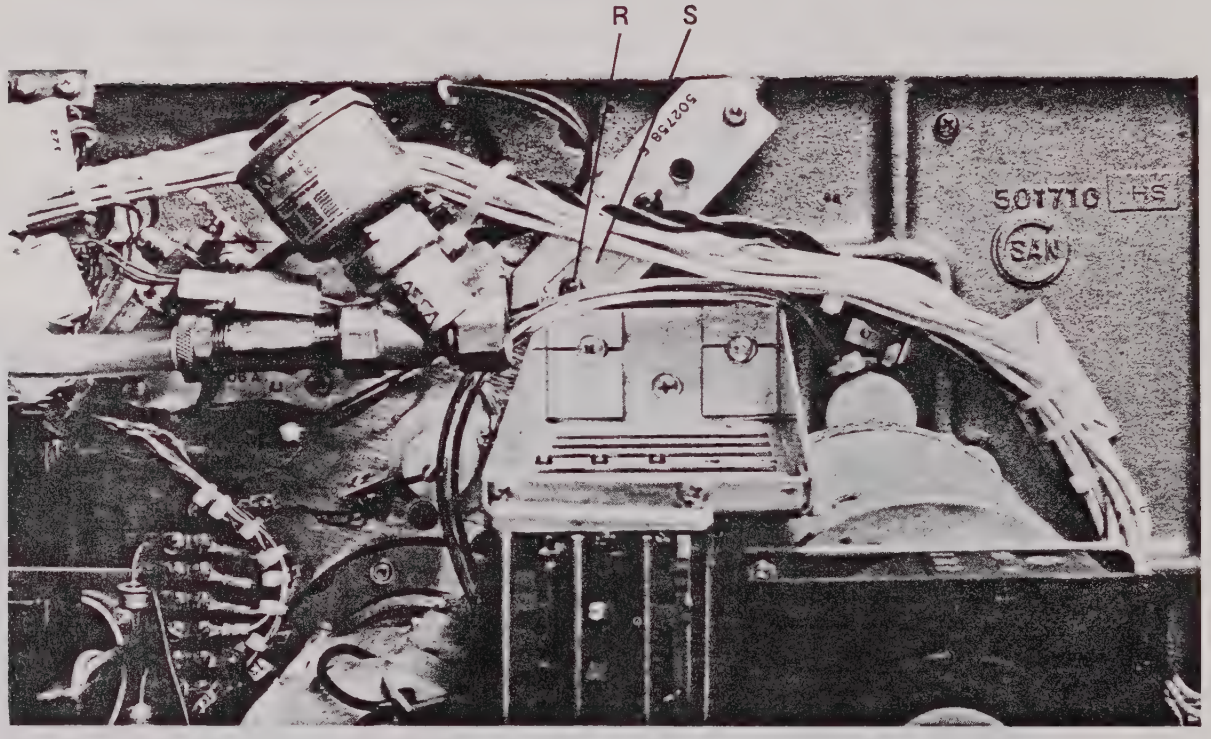


Figure 6-11. Cartridge Pressure Adjustment

8. Tighten screw (R).

9. Power down MTD.

10. Remove manometer, or gauge, and coupling adapter.

11. Release cartridge switch.

6.3 SENSORS

For the following adjustments the MTD should be powered ON with the supply hub empty of tape.

6.3.1 BOT SENSOR (ON −3.5V; OFF 0 to −1.0)

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent).

2. Alignment Tool (Bourns Trimpot or equivalent).

3. Opaque Object – Such as a piece of mag tape.

B. Procedure:

1. Set oscilloscope to read 0-5VDC and adjust ground reference.

2. Connect Channel 1 of oscilloscope to P52 (Tape Transport PCB) Test Point BOTA. Sync: Internal.

3. This test point should read -3.5 VDC. If it does not read this voltage, adjust trimpot marked BOT to obtain this reading.

4. Block the BOT sensor with an opaque object. (See Figure 6-12).

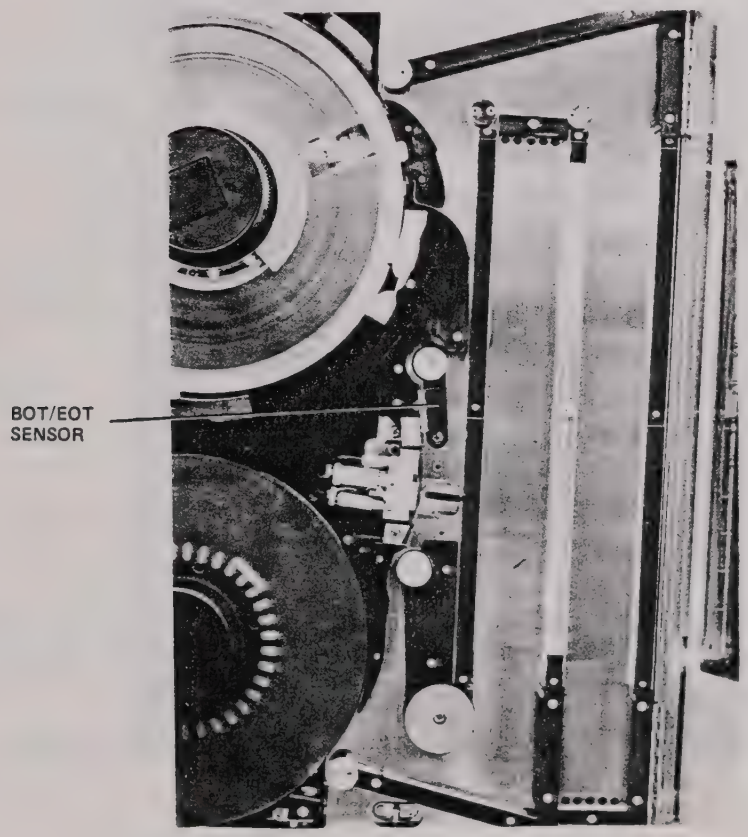


Figure 6-12. BOT/EOT Sensor

5. Test Point BOTA should now read 0 to -1.0 VDC.

6. Connect Channel 2 of the oscilloscope to P52 Test Point BOT. This test point should vary with the other test point.

6.3.2 EOT SENSOR (ON = 3.5V : OFF = 0 to -1.0V)

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent)

2. Alignment Tool (Bourns Timpot or equivalent)

3. Opaque object – Such as a piece of mag tape.

B. Procedure:

1. Set oscilloscope to read 0-5 VDC and adjust ground reference.

2. Connect Channel 1 of oscilloscope to P52 (Tape Transport PCB) Test Point – EOTA. Sync: Internal.

3. This should read -3.5 VDC, if it does not read this voltage, adjust trimpot marked EOT to obtain this reading.

4. Block the EOT sensor with an opaque object (See Figure 6-12).

5. Test Point EOTA should now read from 0 to –1.0 VDC.

6. Connect Channel 2 of the oscilloscope to P52 Test Point EOT. This test point should vary with the other test point.

6.3.3 LOW TAPE SENSOR (ON -4V; OFF 0 to -1.0V)

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent)

2. Alignment Tool (Bourns Trimpot or equivalent)

B. Procedure:

1. Set oscilloscope to read 0-5 VDC and adjust ground reference.

2. Connect Channel 1 of oscilloscope to P52 (Tape Transport PCB) to test point LTPA. Sync: Internal.

3. This test point should read -4.0 VDC. Line up reflective marker (See Figure 6-14) on take-up reel to reflect maximum light to LTP photocell (See Figure 6-13). If it does not read -4.0VDC, adjust LTPA trimpot to obtain this reading.

4. Rotate take-up reel to a point where reflective marker is away from light source and photocell.

5. Test Point LTPA should now read 0 to -1.0 VDC.

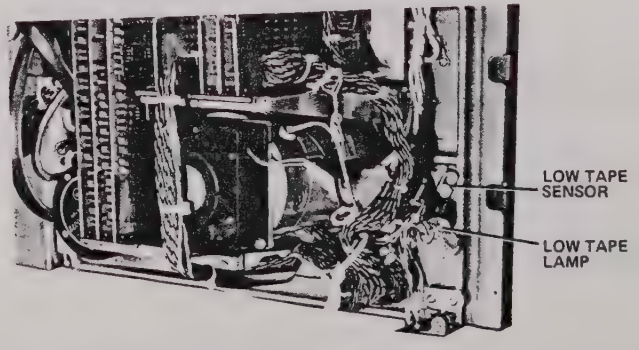


Figure 6-13. Low Tape Sensor

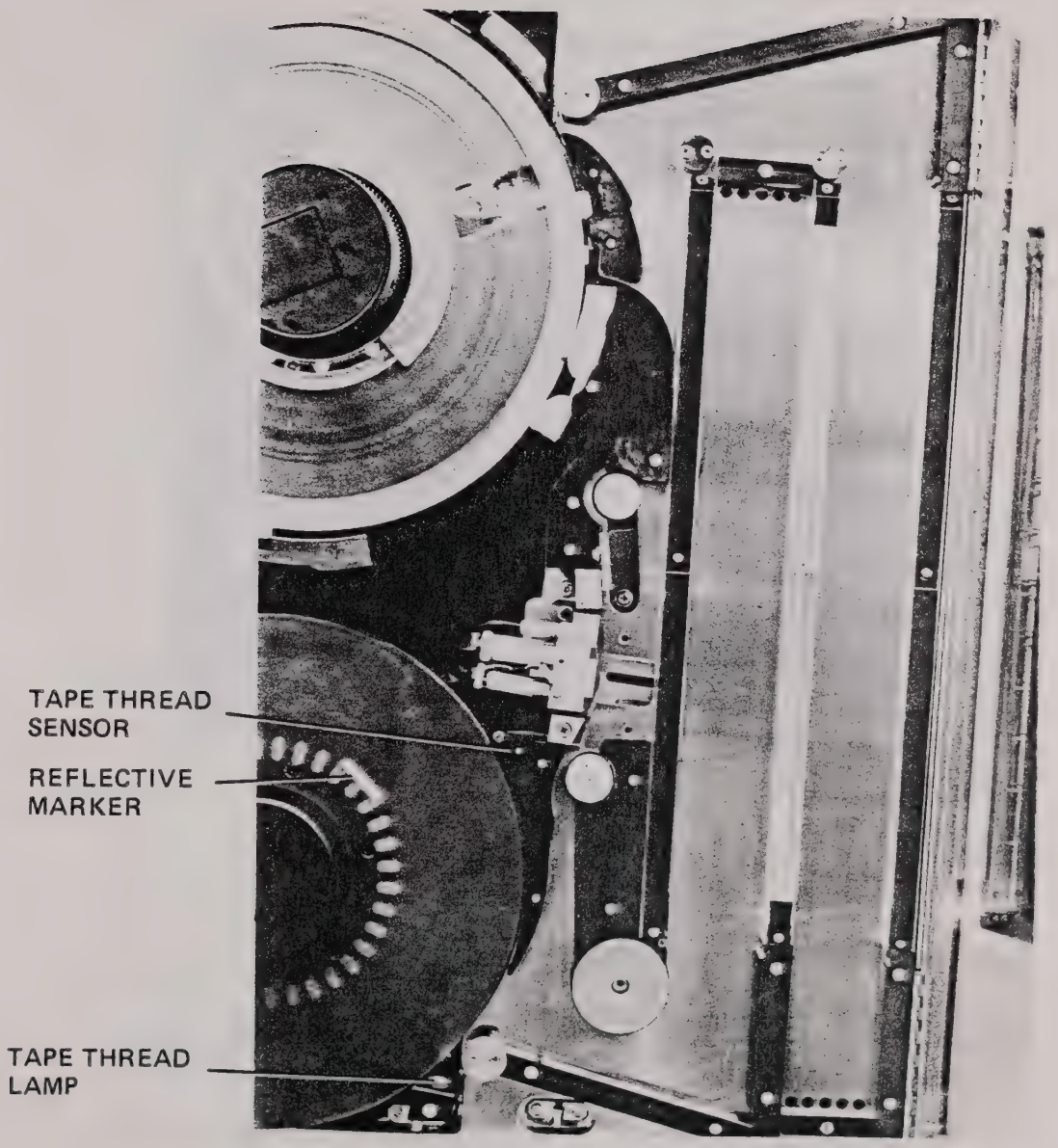


Figure 6-14. Tape Thread Sensor

6.3.4 TAPE THREAD SENSOR (ON -4.0 V: OFF 0 to -1.0 VDC

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent)
2. Alignment Tool (Bourns Trimpot or Equivalent)
3. Opaque Object – such as a piece of mag tape.

B. Procedure:

1. Set oscilloscope to read 0-5 VDC and adjust ground reference.

2. Connect Channel 1 of oscilloscope to P52 (Tape Transport PCB) to Test Point TTPA. Sync: Internal.

3. This test point should read -4.0 VDC. If it does not, adjust TTPA Trimpot to obtain this reading.

4. Now block sensor with an opaque object (see Figure 6-14).

5. Test Point TTPA should read 0 to -1.0 VDC.

6.3.5 SAFETY SENSOR CHECK (ON = 0 to -5V; OFF = +3 VDC min)

NOTE

It is imperative that these checks be performed before attempting any Reel Servo adjustments.

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent).

2. Opaque object — such as a piece of mag tape.

3. I.C. Chip clip extender.

4. PCB Extender (MDS No. 950202801).

B. Procedure:

1. Power down MTD.

2. Remove P52 (Tape Transport PCB) and place on PCB extender.

3. Place an I.C. Chip Extender on IC 1306.

4. Apply power to MTD.

5. Set oscilloscope to read 0 to 5 VDC and adjust ground reference.

6. Take-Up Tank Outer Sensors (A) (Refer to Figure 6-15).

   a. Connect Channel 1 of oscilloscope to IC 1306 pin 4. The voltage at this point should be 0 to -0.5 VDC.

   b. Block Sensor (A) with an opaque object.

   c. The voltage level at IC 1306 pin 4 should now be +3V minimum.

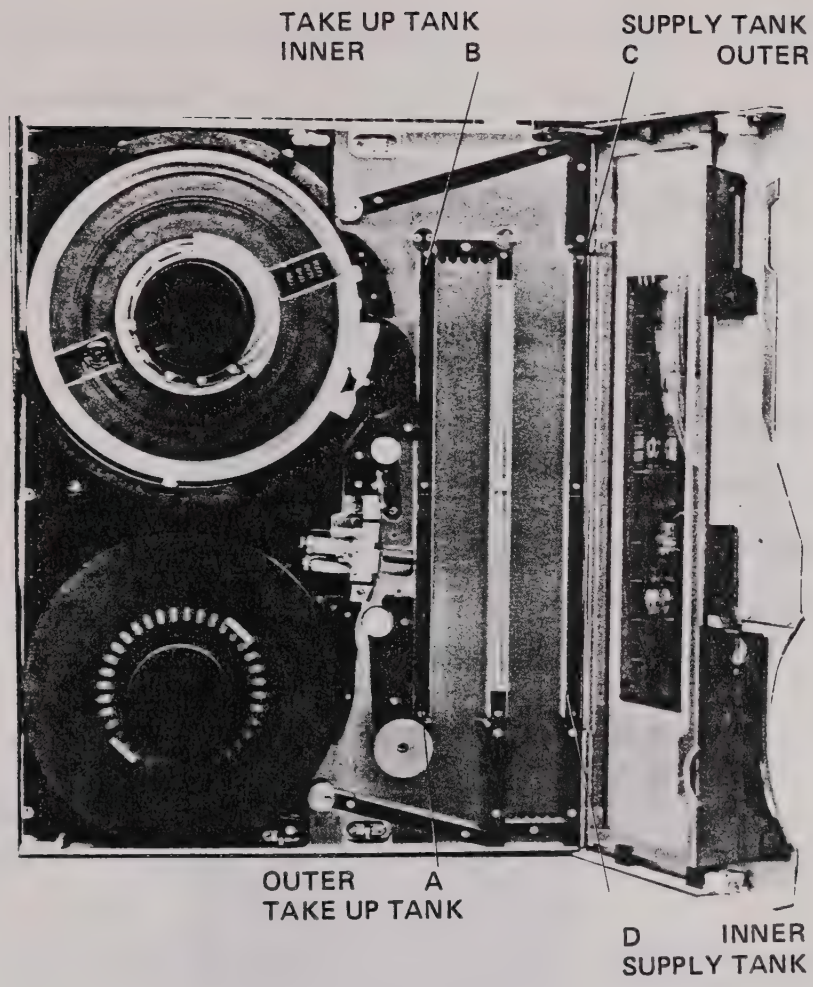


Figure 6-15. Safety Sensors

7. Take-Up Tank Inner Safety Sensor (B) (Refer to Figure 6-15).

   a. Connect Channel 1 of oscilloscope to IC 1306 pin 2. The voltage at this point should be 0 to -0.5 VDC.

   b. Block Sensor (B) with an opaque object.

   c. The voltage level at IC 1306 pin 2 should now be +3V minimum.

8. Supply Tank Outer Safety Sensor (C) (Refer to Figure 6-15).

   a. Connect Channel 1 of oscilloscope to IC 1306 pin 3. The voltage at this point should be 0 to -0.5 VDC.

   b. Block Sensor (C) with an opaque object.

   c. The voltage level at IC 1306 pin 3 should now read +3 VDC minimum.

9. Supply Tank Inner Safety Sensor (D) (Refer to Figure 6-15).

   a. Connect oscilloscope Channel 1 to IC 1306 pin 1. The voltage at this point should be 0 to -0.5 VDC.

   b. Block Sensor (D) with an opaque object.

   c. The voltage level at IC 1306 pin 1 should now read +3 VDC minimum.

6.3.6 REEL SERVO SENSORS (Refer to Figure 6-16)

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent)
   or
2. Digital Voltmeter
3. Alignment tool (Bourns Trimpot or equivalent).
4. 2400' reel of scratch tape.
5. 2 - 6" test jumpers.

6.3.6.1 Initial Procedure:

NOTE

THE INITIAL PROCEDURE SHOULD BE DONE WHENEVER ANY COMPONENT IN THE REEL SERVO SECTION IS REPLACED OR WHEN TAPE CANNOT BE LOADED INTO THE VACUUM TANKS.

1. Connect oscilloscope Channel 1 (or DVM) to Test Point SNS on Supply Amplifier (A3, A2 – refer to Figure 6-16)
2. Turn SL*, SU*, TL*, and TU* pots to minimum resistance.

***NOTE**

If pots are brown – turn fully counterclockwise. If pot inserts are white – turn fully clockwise.

3. Power up the MTD. Do not load tape in vacuum tanks.
4. Adjust Supply Offset (SO) pot for +2.0V ±.2V.
5. Adjust Supply Upper (SU) pot for 0V ±.2V.
6. Adjust Supply Lower (SL) pot for -2.0V ±.2V.
7. Connect oscilloscope Channel 1 (or DVM to Test Point TNS on Take-up Amplifier (A3-A1 - top PCB).
8. Adjust Take-up Offset (TO) pot for +2.0V ±.2V.

9. Adjust Take-up Upper (TU) pot for 0V ±.2V.

10. Adjust Take-up Lower (TL) pot for -2.0V ±.2V.

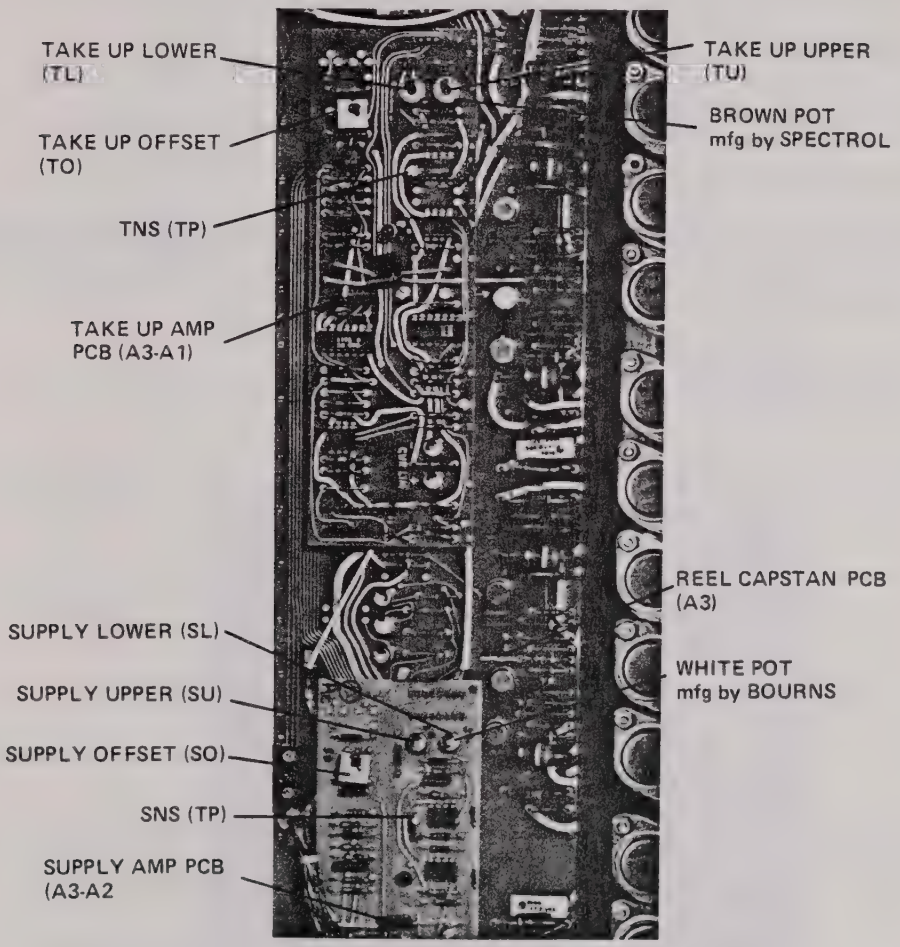


Figure 6-16. Reel Capstan Control PCB

6.3.6.2 Final Servo Sensor Adjustment:

NOTE

This Section of the Reel Servo adjustment should be all that is necessary when component replacement is not required. The procedure is the same for either tank and is written for the Take-up tank with references to the Supply Tank equivalent adjustment shown in brackets: i.e., TO [SO].

CAUTION

COMPONENTS MUST BE AT OPERATING TEMPERATURE. WARM UP FOR AT LEAST 30 MINUTES BEFORE MAKING ANY OF THE FOLLOWING ADJUSTMENTS.

1. Connect oscilloscope Channel 1 (or DVM) to Test Point TNS [SNS] on Take-up Amplifier PCB (A3-A1 – top PCB) or Supply Amplifier [A3-A2 bottom PCB] refer to Figure 6-16.

2. Set scope for 3V full range deflection and set ground level for center of the screen.

3. Load scratch tape into MTD until BOT is reached.

4. Depress Power OFF button on control panel.

5. Manually remove tape from Take-up and Supply tanks.

6. Ground Test Point VMD on P52 (Transport Control PCB) or unplug J28 and J29 (see Figure 6-17). This will allow the vacuum system to hold the tape in the tank, but will not permit drive to the Servo Motors.

7. Apply power to MTD.

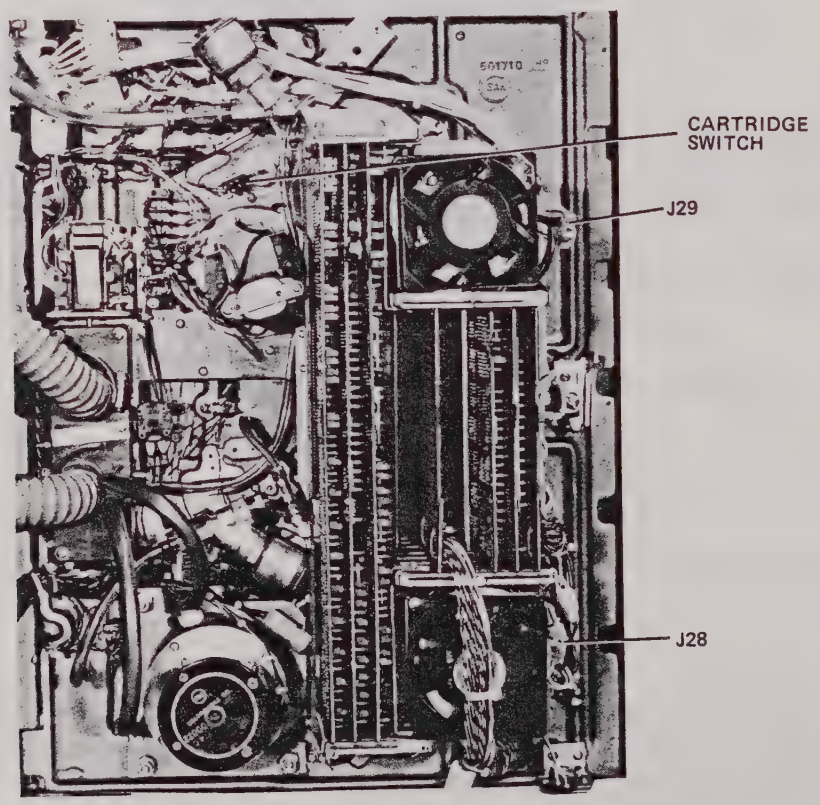


Figure 6-17. Rear View of Front Casting

8. Manually load Take-up tank [supply tank] with tape to the 4" mark on the inner portion of the tank and hold it there.

   If inch marks are not present, place masking tape next to openings and mark center position on each tank '0'. Then at each inch away from center, make a mark for up to 6 inches. Label these 1 thru 6 in each direction.

NOTE

Consult Figure 6-15 for inner and outer positions on tank as they differ.

9. Adjust Offset pot TO [SO], to obtain a reading on oscilloscope (or DVM) of +1.2V.

10. Rotate the reel to set tape at the 0 inch mark in the tank and hold it there. Note the voltage at test point TNS [SNS] at this time.

11. Divide the voltage value in step 10 by 2 and change its sign.

    Example: Noted voltage in step 10 =−.80V
    Desired voltage value in step 11 = +.40V

12. Adjust the Lower pot TL [SL] to obtain the voltage you calculated in step 11.

13. Repeat steps 8 thru 12 until the 4" inner tank voltage and the 0" tank voltage are +1.2 and 0V respectively.

14. Rotate the reel to set tape to the 4" outer tank mark and hold it there.

NOTE

Consult Figure 6-15 inner and outer position of tanks as they differ.

15. Adjust the Upper pot TU [SU] to obtain a reading of −1.2V.

16. Recheck the 4" inner tank voltage and the 0" voltage. If they are off by more than ±.1V from the desired voltage of +1.2V and 0V respectively, repeat steps 8 thru 15 until all three voltages can be obtained within the ±.1V tolerance.

17. Remove tape from the Take-up tank (supply tank).

NOTE

If other tank needs adjustment also, return directly to step 1 of this procedure. If the other tank does not require adjustment, proceed with step 18 below.

18. Drop power to MTD by setting power switch to OFF position.

19. Remove ground from Test Point VMD or reconnect J28 and J29 as required.

20. Apply power to MTD by setting power switch to ON position.

21. Depress Reset button on the control panel.

22. Depress Load button on the control panel to load tape into tanks.

23. When tape is loaded in both tanks, adjust Offset pots (TO, SO) so that tape rests at 0" mark ±1/4". Be sure to check this in both directions by manually turning the Take-up reel and supply reels in alternate directions and allowing the servo amplifiers to return the tape to its center (or 0) position.

6.4 Servo System

6.4.1 Take-Up Thread Speed (110-150 RPM, See Step 5)

NOTE

Two methods of making this adjustment are given below. Depending upon which tool you use, you should follow either the (a) or (b) method. Where neither (a) nor (b) is noted by the step or tool, it is common to both methods.

A. Tools Required:

1.a. 0 -1000 RPM Hand Tachometer (Jacquet No. 2302 or equivalent).
b. Oscilloscope (Tektronix 535 or equivalent).

2. Alignment Tool (Bourns Trimpot or equivalent).

B. Procedure:

1. Unload and remove any reel or cartridge of tape from Supply Hub. Then power down MTD.

2.a. On Transport Logic PCB (P52) ground test point LTPA.
b. Ground test point LTP.

3. Power up MTD, depress Reset button and Load button on control panel. The Take-up reel should be turning clockwise and the supply reel should be stopped.

4.a. Place Hand Tachometer on hub of Take-up reel and note RPM.
b. Connect oscilloscope Channel 1 to test point LTPA on P52.

5.a. On the Reel and Capstan Control PCB (A3) adjust R-263 (Take-up thread speed pot) — See Figure 6-18 — to obtain a RPM reading in accordance with the Table 6-2.
b. Adjust R263 to obtain a L.E. to L.E. time in accordance with Table 6-2, using the signal at LTPA.

Table 6-2. Take-Up Thread Speed

Drive Condition	Speed (RPM)	LTPA Pulsetime
Cooled Off	110 ±5	280 msec.
Moderate Use	130 ±5	255 msec.
Heavy Use	150 ±5	200 msec.

6. Depress Reset button on control panel to stop Take-up reel motion.

7.a. Remove ground from P52 Test Point LTPA.
b. Remove ground from P52 Test Point LTP.

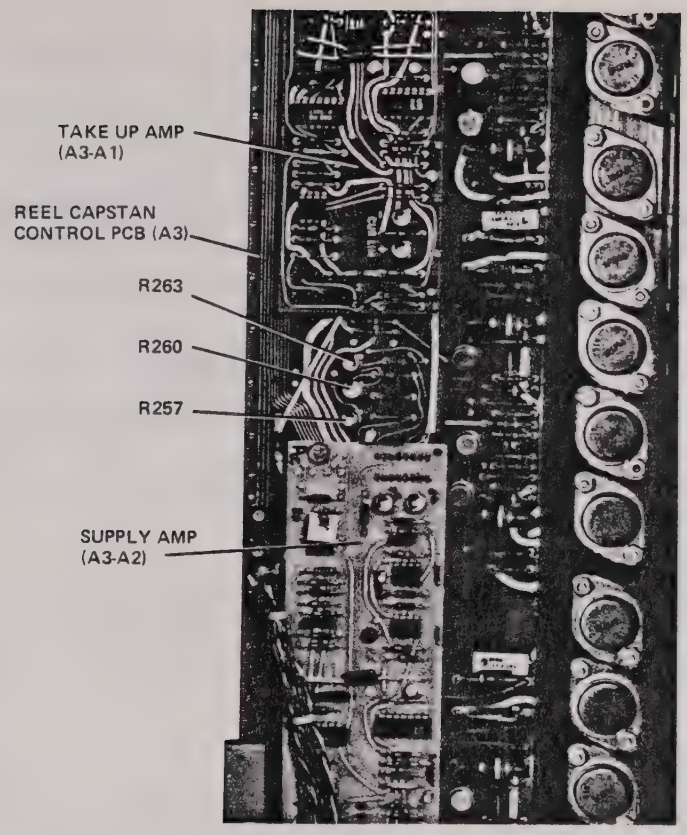


Figure 6-18. Speed Adjustments

6.4.2 Supply Thread Speed (40-56 RPM, See Step 6)

NOTE

Two methods of making this adjustment are given below. Depending upon which tool you use you should follow either (a) or (b) method. Where neither (a) nor (b) is noted by the step or tool, it is common to both methods.

A. Tools Required:

1.a. 0-1000 RPM Hand Tachometer (Jacquet No. 2302 or equivalent).
b. Ordinary wrist watch with second hand.

2. Alignment tool (Bourns Trimpot or equivalent)

B. Procedures:

1. Unload and remove any reel or cartridge of tape from Supply Hub. Power down MTD.

2. Unplug Take-Up motor at J28. See Figure 6-17.

3. Depress Reset button, then Load button on Control Panel.

4. Rotate the Take-up reel a minimum of 8 passes of the low tape sensor. The Supply reel should now be turning clockwise. If it does not turn, set R260 (See Figure 6-18) to midrange.

5.a. Place the Hand Tachometer on the hub of the Supply reel and note RPM.

b. Place your index finger against the Supply reel hub gently, and count the number of revolutions in a 15 second period.

6.a. On the Reel and Capstan Control PCB (A3) adjust R260 (Supply Thread Speed Pot) see Figure 6-18 to obtain RPM reading in accordance with column 'a' in Table 6-3 below.
b. Adjust R260 to obtain an RPM equal to that shown in "No. of RPM in 15 seconds" column in Table 6-3 below.

Table 6-3. Supply Thread Speed

Drive Condition	(a) Speed (RPM)	(b)No. of RPM in 15 seconds
Cooled Off	40 ±3	10
Moderate Use	48 ±3	12
Heavy Use	56 ±3	14

7. Depress Reset button on Control Panel.

8. Reconnect Take-up motor through J28.

6.4.3 Supply Unthreaded Speed

A. Tools Required:

1.a. 0-1000 RPM Hand Tachometer (Jacquet No. 2302 or equivalent).
b. Ordinary wrist watch with second hand.

2. Alignment Tool (Bourns Trimpot or equivalent)

3. 6" Test Jumper.

B. Procedure:

1. Unload and remove any Tape Cartridge from Supply Hub. Drop power to MTD.

2. Unplug the Take-up motor at J28. (See Figure 6-17)

3. With a test jumper, short the wired terminals on the back of the cartridge switch (See Figure 6-17) or depress and hold plunger of cartridge switch,while making this adjustment.

4. Power up MTD and depress Reset and LOAD buttons on Control Panel.

5. Rotate the Take-up reel a minimum of 8 passes of the Low Tape Sensor. The Supply reel should now be turning clockwise.

6. Rotate the Take-up reel an additional 8 passes of the Low Tape Sensor. The Supply reel should now be turning counterclockwise. If Supply Reel does not turn, set R257 (Figure 6-18) to midrange.

7.a. Place the Hand Tachometer on the hub of the Supply Reel and note RPM.

b. Place your index finger against the Supply reel hub gently and count the number of revolutions in a 15 second period.

8.a. On the Reel and Capstan Control PCB (A3) adjust R257 (Supply Unthread Speed Pot)–See Figure 6-18 to obtain a RPM reading of 100 ±5 RPM.
b. Adjust R257 to obtain approximately 25 turns of the Supply Reel within 15 seconds.

9. Depress Reset button on Control Panel and drop power to MTD.

10. Remove test jumper from cartridge switch.

11. Reconnect Take-up motor through J28.

6.4.4 Forward Capstan Speed (See Table in Step 7)

NOTE

Two methods of making this adjustment are given below. Depending upon which tools you use, you should follow either the (a) or (b) method. Where neither (a) nor (b) is noted by the step (or tool), it is common to both methods.

A. Tools Required:

1.a. 0-1000 RPM Hand Tachometer (Jacquet No. 2301 or equivalent)
b. Oscilloscope (Tektronix 535 or equivalent)

2.a. Digital Voltmeter

3. Alignment Tool (Bourns Trimpot or equivalent).

4.a. 2400' scratch tape.
b. Skew tape (800 BPI).

B. Procedure:

1.a. Load Tape Drive with scratch tape.
b. Load Tape Drive with Skew tape.

2. Connect oscilloscope Channel 1 (or voltmeter) to Transport Control PCB (P52) test point CDV.

3. Adjust NULL pot for 0V ±.01 VDC at CDV test point.

4. Set switches on P52 as follows:

S2 – up to LO
S3 – down to NRZ
S4 – up to RUN
S5 – down to FWD

5.a. Remove red plastic plug from back of capstan motor. (See Figure 6-19).

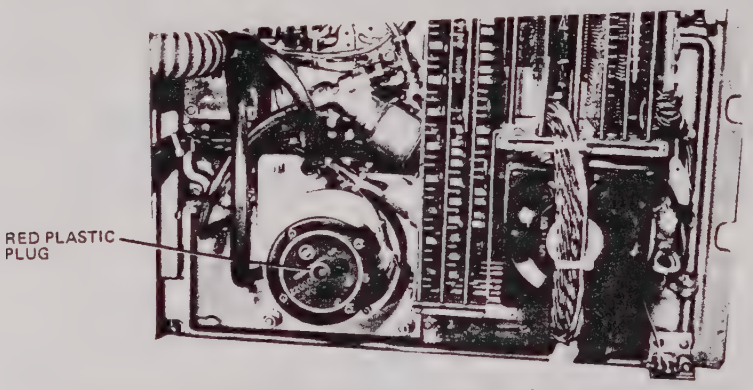


Figure 6-19. Capstan Motor Speed Adjustment

6.a. Insert Hand Tachometer through port onto Capstan Drive Shaft.
b. Connect oscilloscope Channel 1 to test point LA5 on Read Amplifier (P51).

7.a. Adjust FWD pot on P52 for correct RPM per Table 6-4 below, using Hand Tachometer.
b. Adjust FWD pot on P52 for correct L.E. to L.E. time per Table 6-4 below, using signal observed at LA5.

Table 6-4. Forward Capstan Speed

IPS	(a) Capstan Speed (RPM)	(b) L.E. to L.E. at LA5 (usec) ±3%
125	1200 ±12	20.00
75	720 ± 7	33.2

8.a. Replace plastic plug in capstan motor.

6.4.5 Reverse Capstan Speed (See Table in Step 8)

NOTE

Two methods of making this adjustment are given below. Depending upon which tools you use, you should follow either the (a) or (b) method. Where neither (a) nor (b) is noted by the step (or tool) it is common to both methods.

A. Tools Required:

1.a. 0-10,000 RPM Hand Tachometer (Jacquet No. 2301 or equivalent)
b. Oscilloscope (Tektronix 535 or equivalent).

2. Alignment Tool (Bourns Trimpot or equivalent).

3.a. 2400' scratch tape.
b. Skew tape (800 BPI).

B. Procedure:

1.a. Load Scratch tape into Tape Drive.
b. Load Skew tape into Tape Drive.

2.a. Remove red plastic plug from back of Capstan Motor. (See Figure 6-19).

3. Set switches on Transport Control PCB (P52) as follows:

   S2 – up to LO
   S3 – down to NRZ
   S4 – up to RUN
   S5 – down to FWD

4. Run tape forward for about 500 feet.

5. Set S5 up to REV.

6.a. Insert Hand Tachometer through port on to Capstan Drive Shaft.
   b. Connect oscilloscope Channel 1 to Read Amplifier PCB (P51) Test Point LA5.

7.a. Adjust REV pot on P52 for correct RPM as indicated in Table 6-5 below:
   b. Adjust REV pot on P52 for correct L.E. to L.E. time as indicated in Table 6-5 below.

8.a. Replace plastic plug in Capstan motor.

Table 6-5. Reverse Capstan Speed

IPS	(a) Speed (RPM)	(b) L.E. to L.E. at LA5 (usec.)±3%
125	1200 ±12	20.0
75	720 ± 7	33.2

6.4.6 Forward Accelerate & Decelerate (See Table in Step 5)

NOTE

Forward and Reverse capstan speed must be accurate to perform this adjustment.

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent).

2. Alignment Tool (Bourns Trimpot or equivalent).

B. Procedure:

1. Connect oscilloscope Channel 1 to Transport Control PCB (P52) test point RUN.

2. Set switches on Transport Control PCB (P52) as follows:

   S2 – up to LO
   S3 – down to NRZ
   S4 – down to CYCLE
   S5 – down to FWD

3. Adjust FREQ and DUTY pots to obtain a 25 ms RUN/STOP signal per Figure 6-20.

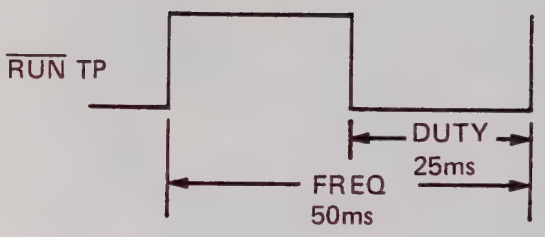


Figure 6-20. RUN TP Waveform

4. Connect oscilloscope Channel 2 to Monitor P52 Test Point RMP. Trigger scope on Internal (–).

5. Adjust ACC pot on P52 to obtain correct accelerate time, as shown in Figure 6-21, per Table 6-6 below.

Table 6-6. Accelerate/Decelerate Time

IPS	ACC/DEC Time
125	2.8 ms
75	4.7 ms

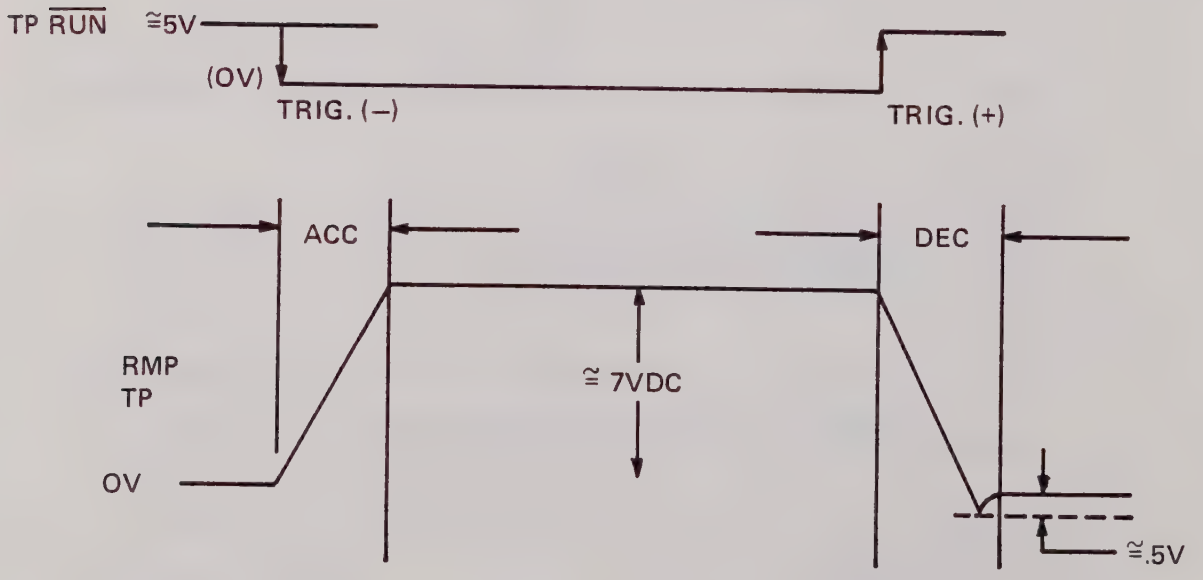


Figure 6-21. Accelerate/Decelerate Wave Forms

6. Change Trigger on oscilloscope to (+).

7. Adjust DEC pot on P52 to obtain correct decelerate time (shown in Figure 6-21) as per Table in Step 5.

6.4.7 REWIND SPEED

A. Tools Required:

1. Oscilloscope or Digital Voltmeter.

2. 2400 ft. reel of scratch tape.

3. Alignment tool (Bourns Trimpot or equivalent).

4. A.C. isolation plug (for scope or DVM).

B. Procedure:

1. Isolate scope or DVM from ground with an A.C. isolation plug.

2. Connect negative lead of scope or DVM to test point GND on Transport Control Board, location P52.

3. Set range on scope or DVM to enable reading 5.0V signal.

4. Monitor test point TFB on P52. If using a DVM set to D.C. range.

5. Load a 2400 ft. reel of tape to BOT.

6. Set the switches on the Transport Control Board:

   S5 – down to FWD
   S4 – up to RUN

7. Allow tape to run until it stops at EOT.

8. Set S4 to OFF (center position).

9. Locate the RWD pot on the Transport Control Board and note the peak adjustment voltage from Table 6-7 below (disregard noise spikes when using scope):

Table 6-7. Rewind Speed

SPEED, RPM (REF)	TFB, PEAK VOLTAGE, VOLTS
4800	+4.70 ±.10

10. Depress LOAD/RWD. Allow approximately 30 seconds for the capstan to reach peak speed, then adjust RWD pot for specified peak voltage in Table.

11. Return to step 6 if additional rewinds are needed, and as a final check.

6.4.8 CURRENT LIMITING ADJUSTMENT:

This procedure is identical for Supply and Take-Up Amplifiers. It is written for the Supply Amplifier with corresponding references to the Take-Up Amplifier given in brackets: i.e., [ ]. Either Amplifier may be adjusted first (or independently).

CAUTION

THE REEL SERVO SENSORS SHOULD BE CHECKED AND ADJUSTED IF NECESSARY PER 6.3.6 BEFORE THIS ADJUSTMENT IS ATTEMPTED.

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent).
2. 2400 ft. reel of scratch tape.
3. Extender card (MDS P/N 950202801).
4. I.C. chip clip.
5. A.C. isolation plug (for scope).
6. Alignment tool (Bourns Trimpot or equivalent).
7. 6" Test Jumper.

B. Procedure:

1. Power down MTD.
2. Isolate scope from ground using A.C. isolation plug.
3. Ground scope to MTD frame.
4. Set any CUR LIM pots not previously adjusted to their midway positions. (Refer to Figure 6-22).
5. Remove Transport Control Board from P52 in module, and reinsert on extender card.
6. Set power switch to ON.
7. Set switches S4 down to CYCLE and S5 down to FWD (on P52).
8. Connect oscilloscope Channel 1 to monitor test point RUN (on P52). Sync scope to internal (+).

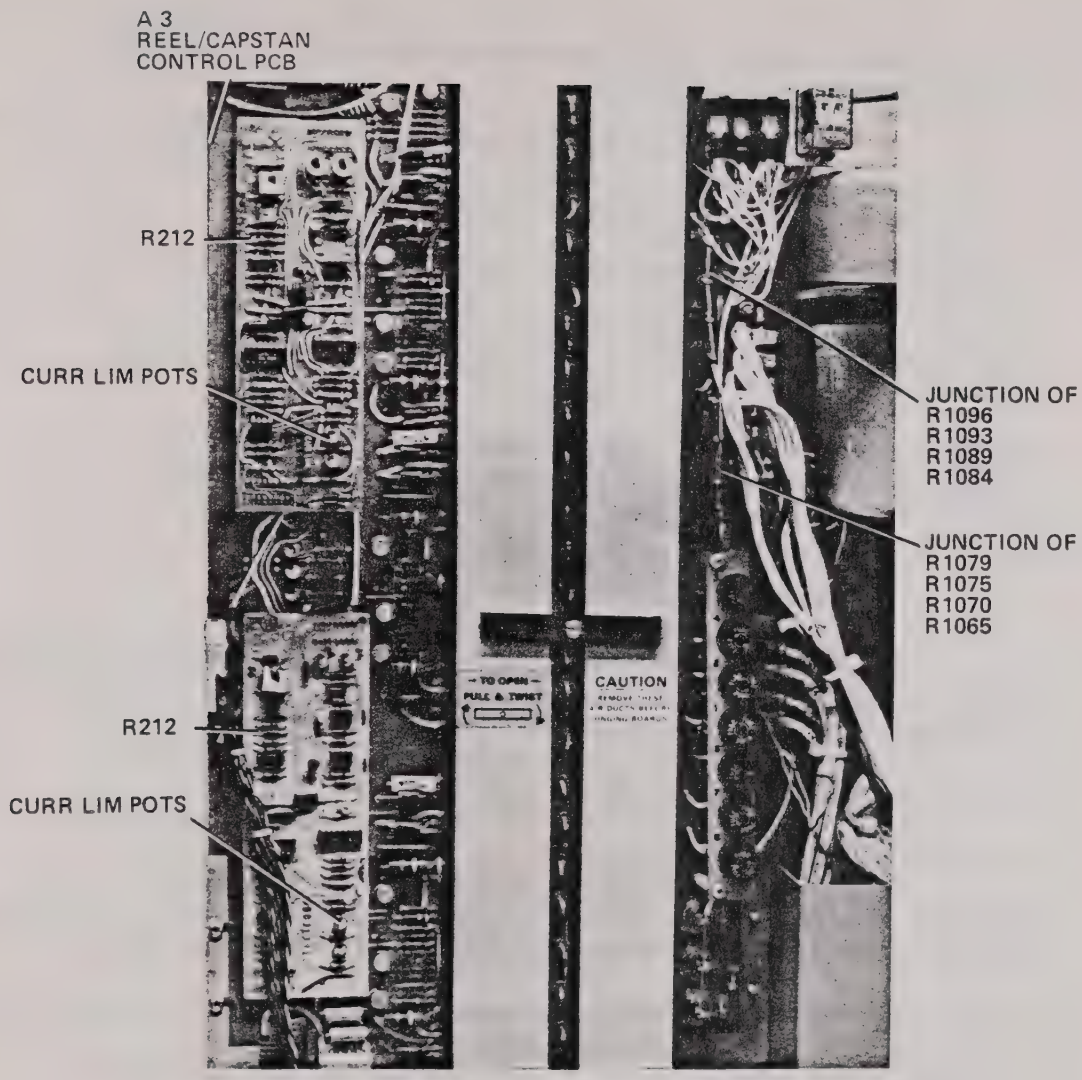


Figure 6-22. Current Limiting Adjustments

9. Adjust FREQ pot for a 200 ms cycle time as shown in Figure 6-23 below.

10. Adjust DUTY pot for a 100 ms period as shown in Figure 6-23 below.

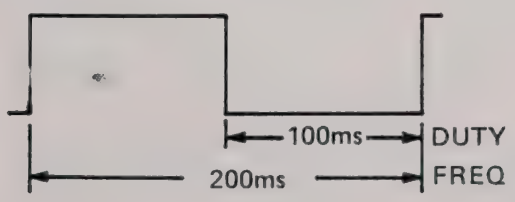


Figure 6-23. RUN Waveform, Channel 1

11. From the Table below determine the zero to peak waveform limit voltages for the tape speed of the unit you are working on.

Table 6-8. Limit Voltages for Current Limiting

TAPE SPEED, IPS:	ZERO-TO-PEAK, MV:	TOLERANCE, ±MV:
125	500	25
75	300	15

NOTE

Some early version MTD's may have short aperture length light rails, (11 inches compared to the present 13-1/4 inches). Current limiting on these other MTD's should be set 25% higher.

12. Adjust ground reference for Channel 2 at center of screen and set vertical deflection to enable viewing the specified limit zero-to-peak voltage (times 2).Reset Channel 2 for DC signal with HF filter on.

13. Set S4 to OFF (center position).

14. Power off MTD.

15. Disconnect scope ground from MTD frame and connect to the junction of R1084-1096 (Supply) [1065-1079 (Take-up)] on Reel Capstan Control PCB (A3) (See Figure 6-22).

16. Connect oscilloscope Channel 2 to the left side of R212 on the Supply Amplifier (A3-A2) [Take-Up Amplifier (A3-A1)] (See Figure 6-22).

17. Install IC chip clip on IC 214 of P52.

18. Short pins 10 to 13 on IC 214 with test jumper.

19. Power up MTD.

20. Load a 2400 ft. reel of tape to BOT.

21. Set S4 down to CYCLE. Tape should now be rapidly cycling forward and reverse.

22. Observing Channel 2 signal, adjust the Supply [Take-Up] "+" CUR LIM pot (bottom pot) to clip the positive waveform peak to the specified value per Table 6-8, as in Figure 6-24b.

23. Adjust the Supply [Take-Up] "–" CUR LIM pot to clip the negative waveform peak to the specified value per Table 6-8, as in Figure 6-24b.

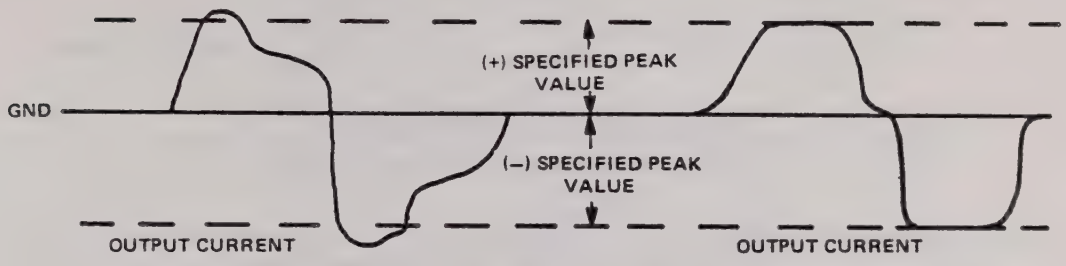


Figure 6-24a. Before Adjustment Figure 6-24b. After Adjustment

Figure 6-24. Channel 2 Waveform

24. Set S4 to OFF.

25. If adjusting current limiting on both reel servos amplifiers, return to step 15 for other amplifier adjustment.

26. Remove jumper on chip clip.

27. Depress UNLOAD button.

28. When tape is fully rewound onto the supply reel, power off MTD.

29. Remove chip clip, probes, and ground connection.

30. Remove extender card and install Transport Control Board in location P52 in electronics module.

31. Remove A.C. isolation plug and reconnect scope line plug (optional).

6.5 TAPE CLEANER ALIGNMENT (See Figure 6-25)

A. Tools Required:

1. Tape Cleaner Alignment tool (MDS P/N 956013401).
2. Number 1 Phillips screwdriver.
3. Number 2 Phillips screwdriver.

B. Procedure

1. Power Off MTD.
2. Remove BOT/EOT window which is fastened by one screw.
3. Remove tape cleaner cover plate which is fastened by two screws.

4. Loosen Tape Cleaner mounting screw.

5. Insert Tape Cleaner Alignment tool (as shown in Figure 6-25) and locate it against R/W head and Erase head. Tighten holding screw for tool.

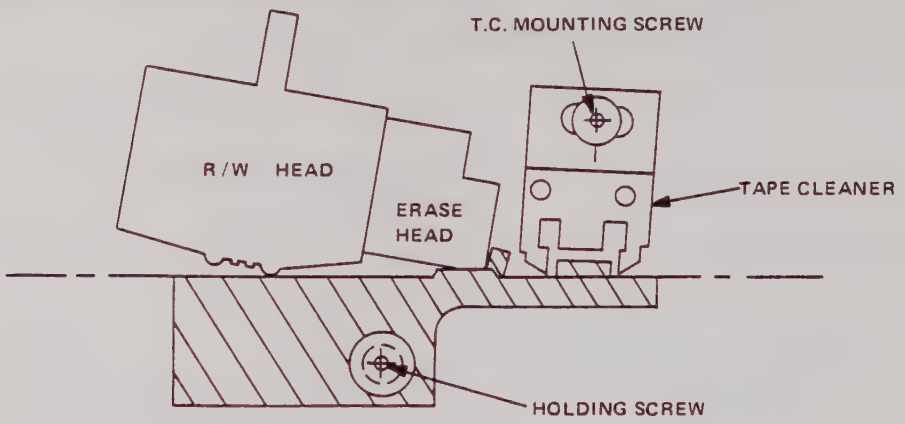


Figure 6-25. Tape Cleaner Alignment

6. Locate Tape Cleaner against alignment tool so that cleaner blades straddle the tool protrusions, as shown in Figure 6-25.

7. Tighten Tape Cleaner mounting screw.

8. Loosen alignment tool holding screw.

9. Press tool against R/W head; Erase head and Tape Cleaner to insure that alignment did not change when tightening mounting screw.

10. Remove alignment tool.

11. Replace Tape Cleaner cover plate.

12. Replace BOT/EOT window.

6.6 READ/WRITE ADJUSTMENTS

6.6.1 WRITE CLOCK (See Table in step 5).

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent)

2. Adjustment tool (Bourns Trimpot or equivalent).

3. 2400' reel of Scratch Tape – with Write Enable ring.

B. Procedure:

1. Place Write Enable ring on Sratch tape and load into MTD.

NOTE

The File Protect indicator will remain lit when in LOCAL mode.

2. On the Transport Logic PCB (P52) set up the following switches:

S2 – down to HI
S3 – either PE or NRZ, depending on MTD type (insure that control panel density switch is making same selection).

S4 – center to OFF
S5 – down to FWD

3. Depress and lock S1 (SET WRITE) to set Write Status in MTD.

4. Connect oscilloscope Channel 1 to P52 Test Point WCLK. The signal to this test point should look like the Figure 6-26 below.

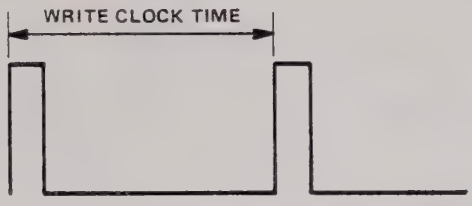


Figure 6-26. WCLK Test Point Signal

5. The timing of the Write Clock should be adjusted via the WCLK pot, according to the speed of the drive you are working on, to match the Table 6-9 below.

Table 6-9. NRZ Timing Chart

IPS	WCLK TIME	CELL PERIOD TIMES (T) USEC NRZ 800 BPI	NRZ 200 BPI	PE HI 3200 BPI	PE LO 1600 BPI
125	2.5	10.0	40.0	2.5	5.0
75	4.2	16.6	66.4	4.15	8.3

6. Use oscilloscope Channel 1 to monitor P53 (Write Amplifier PCB) test points WH1 thru WH9. Each test point should have a 30 VDC signal familiar to Figure 6-27 A or B, depending upon type of drive or density selection if Dual Density versions.

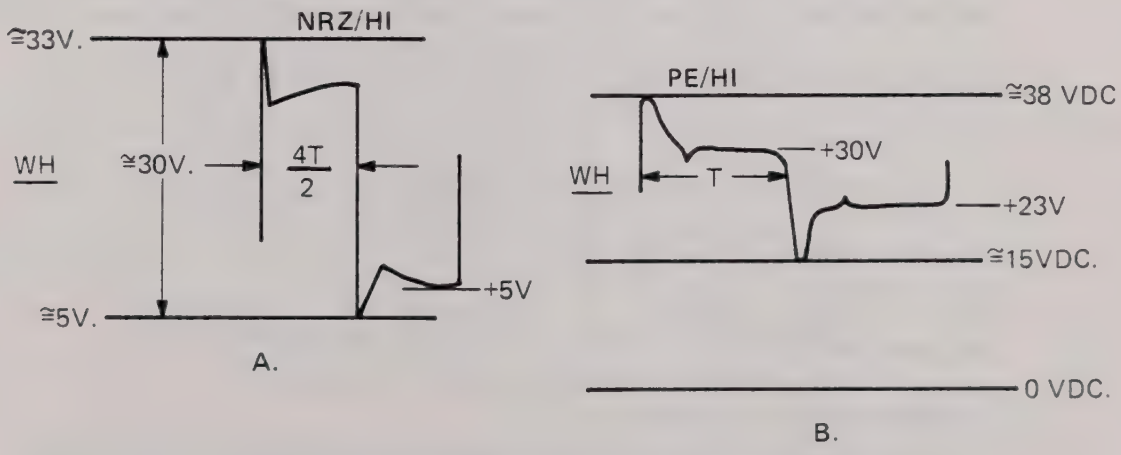


Figure 6-27. Write Amplifier Signals

7. Switch S3 on P52, and Control Panel Density switch, to other density (if MTD has Dual Density) and insure that each test point checked in step 6, above has the correct output for the other density.

6.6.2 READ AMPLIFIER

NRZ	= 4V P–P
Dual Density P.E.	= 2.2 to 3.5V P–P
P.E.	= 2V P–P

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent)
2. Adjustment tool (Bourns Trimpot or equivalent)
3. 2400' reel of Scratch Tape.

6.6.2.1 NRZ and Dual Density Procedure

1. Load scratch tape into MTD.
2. On the transport Logic PCB, set up the following switches:

   S2 – down to HI
   S3 – down to NRZ
   S4 – up to RUN
   S5 – down to FWD

3. Depress and lock S1 (Set Write)
4. Connect oscilloscope Channel 1 to monitor Read Amplifier (P51) test points LA1 thru LA9.
5. Adjust pots RA1 thru RA9, respectively to obtain a 4V P–P sine wave on test points LA1 thru LA9.
6. On the Transport Logic PCB (P52), change switch S3 to P.E.
7. Connect oscilloscope Channel 1 to Monitor Read Amplifier (P51) test points LA1 thru LA9.
8. Each test point should have a signal which is 2.2 to 3.5V peak to peak.

6.6.2.2 P.E. Only Procedure

1. On the Transport Logic PCB (P52), set up the following switches:

   S2 – down to HI
   S3 – up to P.E.
   S4 – Up to RUN
   S5 – down to FWD

2. Depress and lock S1 (Set Write)
3. Connect oscilloscope to monitor Read Amplifier (P51) test points LA1 thru LA9.
4. Adjust pots RA1 thru RA9, respectively, to obtain a 2V peak to peak signal on test points LA1 thru LA9.

6.6.3 HEAD AZIMUTH (±.1 usec)

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent).
2. 7/6" Allen Wrench.
3. Master Skew Tape (IBM or equivalent).
4. 2400 Scratch Tape.

B. Procedure:

1. Load Skew Tape into Tape Drive.
2. On Transport Logic PCB (P52), set up the following switches:

   S3 – down to NRZ
   S4 – up to RUN
   S5 – down to FWD

NOTE

Insure that activator on switch S1 (Set Write) is unlocked and out.

3. Connect oscilloscope Channel 1 to Read Amplifier (P51) test point LA1 and sync internal +.
4. Connect oscilloscope Channel 2 to P51 (Read Amplifier (P51) test point LA2.
5. Adjust the head azimuth screw on R/W head (See Figure 6-28) to minimize skew in both forward and reverse directions.

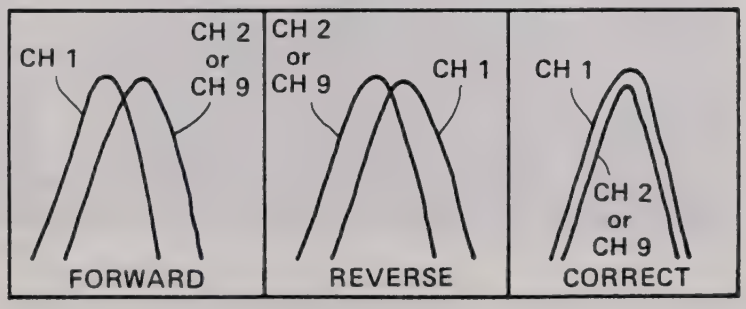


Figure 6-28. Head Azimuth Adjustment Waveform

6. Connect oscilloscope Channel 2 to Read Amplifier (P51) test point LA9.
7. Adjust the head azimuth screw on R/W head(See Figure 6-29)to minimize skew to ±.1 usec. in both Forward and Reverse directions.

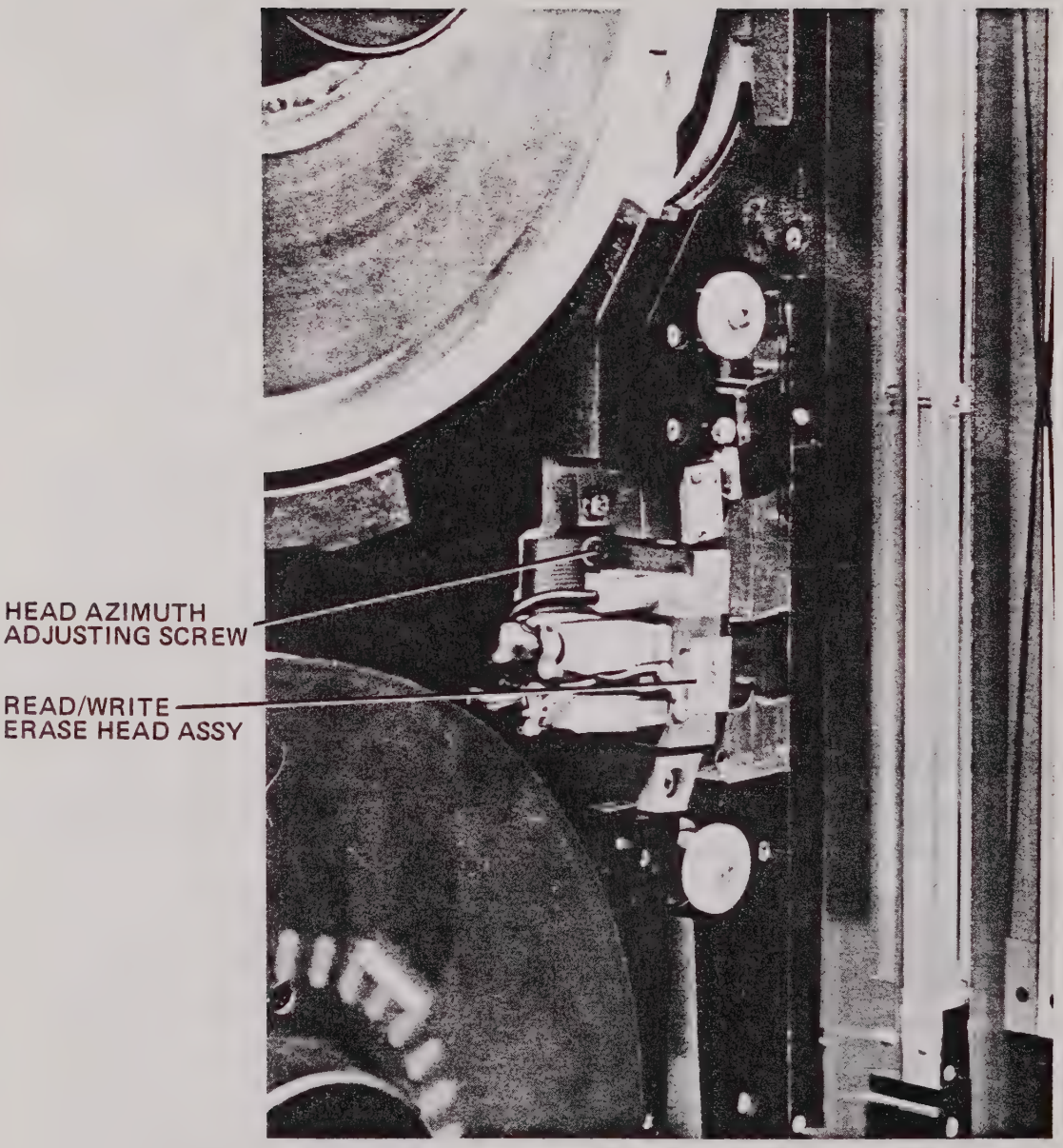


Figure 6-29. Head Azimuth Adjustment

8. If skew cannot be minimized to specs, something is probably steering the tape. Check to see if there are any instructions or foreign matter in tape path area, and that the tape guides have spring action. The BOT mirror should not be interferring with tape cleaner action, and the tape should not rub on threading chutes, etc.

9. If you have set the forward skew to zero, and reverse skew is still out of spec, run reverse and adjust the reverse capstan adjusting screw such that the skew is within 1/2 of what you measured it to be.

NOTE

If you have to adjust capstan screw more than 1/2 turn, something else is steering the tape.

10. Run FWD read. Forward skew should now be out by the amount you adjusted out of reverse skew in step 9. Readjust head Azimuth screw as in step 7.

11. If skew still cannot be minimized to specs, perform Tape Steering Adjustments in the following section.

6.6.4 TAPE STEERING ADJUSTMENTS

NOTE

This adjustment is required only if head azimuth specifications cannot be met or when a capstan motor is replaced.

If the required static skew values, in both FWD and REV operation, cannot be obtained, the tape may be "steering" – that is – shifting its position between FWD and REV operation.

If "steering" is believed to exist, it should be verified by writing all one's on a scratch tape on the unit and reading this tape in both FWD and REV.

Tape steering should be within the values shown in Table 6-10.

Table 6-10. Tape Steering Limitations

IPS	usec.
75	0.9
125	0.5

To view tracking and steering more positively, temporarily replace tape guide assemblies with tape guide bodies only (neither ceramic disks in place) and view the tape motion with the capstan inspection door removed.

The desired tape TRACKING is such that the outboard edge of the tape aligns to the plane of the front (fixed) tape guide. When it is in this position, a slight clearance between the tape and vacuum tank wall will exist at all times.

STEERING must be such that no change of position detectable to the naked eye takes place between forward and reverse operation.

If you decide that excessive "steering" exists, the capstan motor assembly should be adjusted to reduce it to a minimum.

CAUTION

WHEN MAKING ANY OF THE CAPSTAN ADJUSTMENTS, THE LOCKING NUT MUST BE RETIGHTENED AFTER ROTATING THE COLLAR, BEFORE THE RESULTS OF THE ADJUSTMENT CAN BE JUDGED.

ADJUSTMENT PROCEDURE: (Refer to Figure 6-30). Before attempting any dynamic adjustments, make sure that the capstan is in the proper location forward of the vacuum tank surface and that enough clearance exists between it and any adjacent parts. The front surface of the capstan should be .007 in. (±.002) forward of the vacuum column surface and parallel to it. It may be necessary to remove adjacent parts to check this alignment. If it is not in this position, consult section 5 of this manual for capstan height alignment.
Maintain the proper clearance to the Capstan when replacing the block near the capstan.

If the capstan motor assembly is to be moved in or out or tilted, to meet the above conditions, it may be necessary to loosen the locking nuts on the three mounting studs, and rotate the fine-threaded collars.

CAUTION

DO NOT LOOSEN ALL THREE LOCKING NUTS SIMULTANEOUSLY, AS THE ASSEMBLY CAN SHIFT SIDEWAYS IN SUCH A WAY THAT THE CAPSTAN CAN BE DAMAGED.

THEY SHOULD BE LOOSENED AND ADJUSTED INDIVIDUALLY.

Adjustments to correct tape "steering" should be very small – typically less than one turn of any collar.

Only the adjusting collars numbered 1 and 3 are used for dynamic alignment corrections. Collar No. 2 should never be touched once the basic in-and-out Capstan static position has been set.

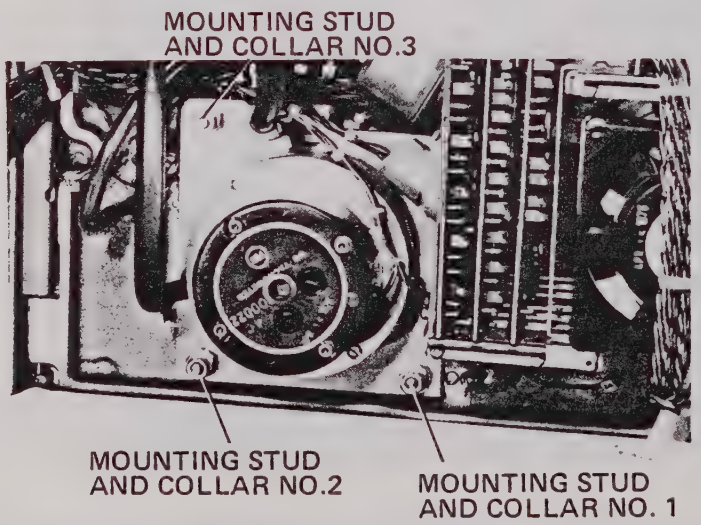


Figure 6-30. Capstan Steering Adjustments

Collar No. 1 is for adjusting STEERING, or change of tape position on the Capstan between FWD and REV operation.

Collar No. 3 is for adjusting LOCATION of the tape on the Capstan.

The two adjustments interrelate:

If, for example, a unit has no steering, but the tape tracks too far in on the Capstan, so that it overcomes the rear spring-loaded tape guide and contacts the vacuum tank rear wall, the basic tape position must be moved out by adjusting Collar No. 3.

After this has been done, some steering will typically appear. This is moved by adjusting Collar No. 1. The tape location may again have to be fine-tuned by Collar No. 3.

The adjustments are thus made in decreasing amounts, until the tape tracks exactly at the fixed guide and does not change its location between forward and reverse.

DIRECTION OF ADJUSTMENT:

If the tape is steering into the vacuum tank rear wall in FORWARD and out in REVERSE (Read waveform will show outboard channel leading inboard channel in either direction) – ADJUST COLLAR NO. 1 CLOCKWISE.

If the tape is steering out from the vacuum tank rear wall in FORWARD and "in" in REVERSE (Read waveform will show outboard channel lagging inboard channel in either direction) – ADJUST COLLAR NO. 1 COUNTERCLOCKWISE.

If steering is minimized, but the tape path is too far into the machine tending to overcome the spring loaded guides, or it drags on the vacuum tank rear wall in either direction – ADJUST COLLAR NO. 3 CLOCKWISE.

If steering is minimized, but the tape path is biased slightly outward-driving too hard against fixed tape guides in either direction – ADJUST COLLAR NO. 3 COUNTERCLOCKWISE.

6.6.5 READ SKEW – NRZ only

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent).

2. Adjustment Tool (Bourns Trimpot or equivalent).

3. Master Skew Tape (IBM or equivalent).

B. Procedure:

1. Load Master Skew Tape into MTD.

2. On Read Amplifier PCB (P51), turn Trimpots FD1 through FD9 and RD1 through RD9 fully counter clockwise to zero. Then turn clockwise one full turn.

3. Connect oscilloscope Channel 1 to test point RDD1 on Amplifier Interface PCB (P52). Sync: Internal +.

4. Set switches on Transport Logic PCB (P52) according to following:

   S2 – Down to H1
   S3 – Down to NRZ
   S4 – Up to RUN
   S5 – Down to FWD

NOTE

Insure that activator on switch S1 (Set Write) is unlocked and out.

5. By observing test points RDD2 thru RDD9 using Channel 2 of oscilloscope, determine which Read signal is most delayed.

6. Connect oscilloscope Channel 1 to RDD test point of most delayed signal as determined in Step 5 above.

7. Using oscilloscope Channel 2, look at and adjust FD Trimpots for other Read signal so that the negative going edge of each signal is in line (time wise) with the latest Channel, according to Table 6-11.

Table 6-11. Skew Test Points and Adjustment Pots

Channel	On Board AC (P57) Test Point	READ SKEW Adjustment Potentiometer Board RA (P51)		WRITE SKEW On WA Board (P53) Adjustment Potentiometers
		Forward	Reverse	
1	RDD1	FD1	RD1	WD1
2	RDD2	FD2	RD2	WD2
3	RDD3	FD3	RD3	WD3
4	RDD4	FD4	RD4	WD4
5	RDD5	FD5	RD5	WD5
6	RDD6	FD6	RD6	WD6
7	RDD7	FD7	RD7	WD7
8	RDD8	FD8	RD8	WD8
9	RDD9	FD9	RD9	WD9

6.6.6 WRITE DE SKEW – NRZ Only

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent).

2. Adjustment tool (Bourns Trimpot or equivalent).

3. 2400' Scratch Tape – with Write Enable ring.

B. Procedure:

1. Load scratch tape into MTD.

2. Connect oscilloscope Channel 1 to P51 (Read Amplifier PCB) test point RDD1. Sync: Internal +.

3. Turn all Trimpots WD1 through WD9 on Write Amplifier PCB (P53) fully counter clockwise to zero. Then turn clockwise one full turn.

4. Set switches on Transport Logic PCB (P52) to following positions:

   S2 – Down to HI
   S3 – Down to NRZ
   S4 – Up to RUN
   S5 – Down to FWD

NOTE

Since this is a Write adjustment switch S1 (Set Write Status) must be activated. Depress and turn actuator 1/4 turn to the right to lock into position.

5. By observing test points RDD2 through RDD9 using Channel 2 of the oscilloscope, determine which is the latest signal.

6. Connect oscilloscope Channel 1 to RDD test point which has the latest signal (as determined in Step 5 above.)

7. Using oscilloscope Channel 2, look at and adjust WD Trimpots for other Write signals so that the negative going edge of each signal is in line (time wise) with the latest Channel according to Table 6-11.

6.6.7 WRITE COMPENSATION – Dual Density and PE only

A. Tools Required:

1. Oscilloscope (Tektronix 535 or equivalent).

2. Adjustment Tool (Bourns Trimpot or equivalent).

3. 2400' Scratch Tape with Write Enable ring.

B. Procedure:

1. Load scratch tape into MTD.

2. On P53 (Write Amplifier PCB) turn pots WC1 through WC9 full counterclockwise.

3. Set switches on Transport Control PCB (P52) as follows:

S2 – Up to LO
S3 – Up to PE –(Make sure that control panel selection concurs with this).
S4 – Up to RUN
S5 – Down to FWD (Write compensation can be adjusted only with forward tape motion).

Set S1 (Set Write Status) switch to 'ON' and lock plunger in by turning clockwise to 1/4 turn.

4. Connect oscilloscope Channel 1 to P51 (Read Amplifier PCB) test point DA1.

5. Adjust WC1 pot, on P53, clockwise so that a symetrical waveform is obtained. See Figure 6-31.

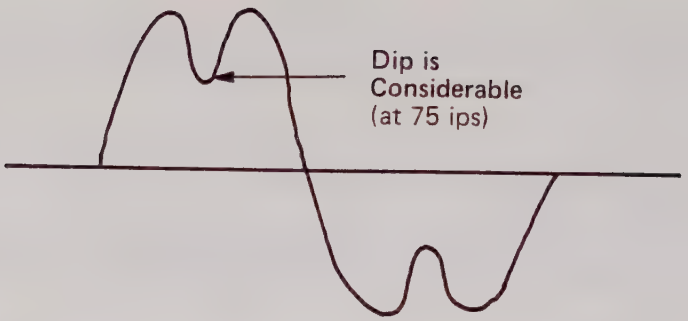


Figure 6-31. Symetrical Write Waveform

6. Turn pot counterclockwise from the symetrical position until a waveform similar to that in Figure 6-32 is obtained. The ratio of B to A should not be less than 80%.

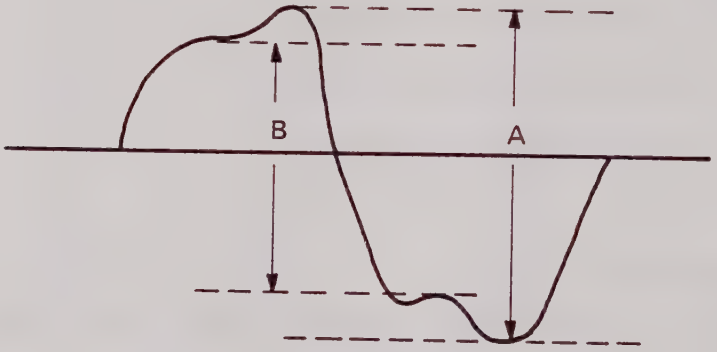


Figure 6-32. Recommended Write Waveform

7. Perform steps 4 through 6 on other channels as per Table 6-12 below.

Table 6-12. Write Compensation Test Points and Adjustment Pots

P51 Test Point	P53 Adjustment	PE Channel
DA1	WC1	1
DA2	WC2	2
DA3	WC3	3
DA4	WC4	4
DA5	WC5	5
DA6	WC6	6
DA7	WC7	7
DA8	WC8	8
DA9	WC9	9

SECTION VII

PCB ASSEMBLIES/SCHEMATICS & RECOMMENDED SPARE PARTS

7.1 Model 4025 PCB Assemblies and Schematics

Listed below in Table 7-1, are the Printed Circuit Board Assemblies and their associated Schematic Drawings utilized in the 4025 MTD.

Table 7-1. PCB Assemblies and Schematics

TAPE TRANSPORT	PCB ASSEMBLY NO.	SCHEMATIC NO.
Transport Schematic and P.S.	N/A	0062180
Transport Logic	950195820	9501956
Regulator	950309408	9503092
Reel & Capstan Control	950367310* or 006205901**	9503131
Take-Up Amplifier	950313611	9503134
Supply Amplifier	950313910	9503137
Notes: *Faston Lugs **Ring Lugs		
INTERFACE		
Driver & Receivers	950196113	9501959
Amp Interface PE/NRZI	950196418	9501962
Amp Interface 800/200	950256208	9502560
Amp Interface 800/556	950314805	9503146
Amp Interface 556/200	950315105	9503149
READ AMP		
PE/NRZI & NRZI Only	950195514	9501953
PE Only	950196711	9501965
PE/NRZI & NRZI Only (75 ips)	006181601	0061817
PE Only (75 ips)	006182701	0061828
WRITE AMP		
PE/NRZI	950194607	9501944
PE Only	950194905	9501947
NRZI Only	950195204	9501950

7.2 Model 4025 Recommended Spare Parts List

Listed below in Table 7-2, are the recommended spare parts necessary for field maintenance of the 4025 MTD. The prices shown are subject to change.

Table 7-2. Model 4025 Recommended Spares List

MDS Part Number	Bucode Part Number	Description	Qty. Per Unit	Recommended Quantity Site	Recommended Quantity Depot	Unit Price
134010843	S535-004	Capacitor, 25 VDC, 8200 UF	1		1	$ 5.48
134010850	S535-003	Capacitor, 25 VDC, 1800 UF	1		1	13.41
134010903	S535-007	Capacitor, 50 VDC, 3900 UF	1		1	5.60
134011115	S535-017	Capacitor, 50V, 4000 UF	2		1	21.15
134011142	S535-016	Capacitor, 1000V, 2600 UF	1		1	10.50
167002501	S522-005	Diode Rectifier, 45527-200T	1		1	13.08
167002601	S522-009	Diode, Full Wave Rectifier IN4436T	1		1	11.40
167002701	S522-012	Diode Rectifier, IN4720	4		1	.88
167002901	S522-017	Power Rectifier, 40A	1		1	$ 18.60
192002701	S553-001	Vacuum Blower	1		1	124.50
203001602	S538-016	Fuse, 1A	2	10	40	.30
203001604	S538-015	Fuse, 3A	1	10	40	.65
203101003	S538-005	Fuse, 2A, 250V	1	10	40	.51
203101005	S538-008	Fuse, 5A, 250V	3	20	60	.47
203130019	S538-009	Fuse, 10A	1	10	40	.47
203132019	S538-014	Fuse, 10A, Slow Blow	5	20	60	.42
203132021	S538-019	Fuse, 20A, Slow Blow	6	20	60	.60
255010601	S544-004	Indicator, Lampholder	6	—	5	2.10
302002704	S532-004	Lamp, EOT/BOT/Low Tape	2	2	10	.52
302007301	S532-001	Lamp, Servo/Thread	3	2	10	.60
302007801	S532-008	Lamp, Marco	6	3	20	1.10
327007801	S551-006	Motor, AC	1	—	1	116.50
378000801	S539-100	Conn, 3 Wire TW Lock Female	1	—	1	15.80
387001606	S527-048	Resistor, 2K, 5W	6	—	2	.72
387005502	S527-018	Resistor, 1 OHM, 25W	1	—	1	1.05
416002901	S531-036	Switch Power	1	—	2	4.30
416020201	S531-029	Switch, Vacuum	1	—	2	15.40
416020301	S531-031	Switch, Pushbutton	4	—	5	3.03
416115004	S531-004	Switch, Interlock	1	—	3	8.16
434005701	S541-009	Transformer	1	—	1	210.00
436017601	S542-003	Photocell FPT 120	6	1	5	3.40
530106018	S039-010	Belt	1	1	5	4.00
530106019	S039-009	Belt Sm (50 Hz only)	1	1	5	3.50
530106029	S039-007	Belt	1	1	5	4.47
530106030	S039-003	Belt Lg. (50 Hz only)	1	1	5	4.70
632007401	S021-001	Fastener Pawl Flush Hd.	1	—	1	3.30
637002301	S047-010	Filter, Pressure Pump	4	2	10	.30
808001701	S028-002	Compressor	1	—	1	74.00
820105316		Spring	1	—	3	.27
870002101	S020-026	Spring, Garter	1	—	3	.42
870002201	S020-029	Spring Tension Detent	1	1	3	.32
870002301	S021-007	Spring Latch Assy.	4	—	2	1.26
870003009	S020-038	Spring, Compression	3	—	3	.25
910001201	A100012	Read/Write Erase Head 9 Ch.	1	—	1	1376.00
910001401	A100014	Read/Write Erase Head 7 Ch.	1	—	1	1232.00

Table 7-2. Model 4025 Recommended Spares List (Cont'd.)

MDS Part Number	Bucode Part Number	Description	Qty. Per Unit	Recommended Quantity		Unit Price
				Site	Depot	
950040101	P500401	Low Tape Sensor	1	—	3	12.48
950040502	P500405	Cartridge Motor Assy.	1	—	1	237.00
950041501	P500415	EOT/BOT Sensor, Module Assy.	1	—	3	15.84
950319001	P500644	Tape Cleaner Subassembly	1	—	2	135.50
950098702	P500987	Solenoid Valve Assembly	1	—	3	51.76
950158501	B501585	Spring Endless	1	1	3	9.50
950180301	C501803	Hub Detent	2	—	1	3.00
950192501	P501925	Capstan Motor w/Capstan 125 ips	1	—	1	617.00
950192601	P501926	Tank Sensor Assembly	2	—	5	19.15
950192801	P501928	File Protect Assembly	1	—	2	41.50
950193201	P501932	Servo Mtr Assembly 125 ips	2	—	1	
950359101		Solenoid Valve Assy.	1	—	1	51.20
950193301	P501933	Tape Guide Assembly	2	—	2	$ 36.25
950194001	P501940	Dust Cover Assembly	1	—	1	88.25
006205201		Air Bearing, Inner Lower	2	—	1	35.00
006205101		Air Bearing, Inner Upper	2	—	1	35.00
950377201		Air Bearing, Outer	2	—	1	4.50
950202801	P502028	Extender Card	—	1	1	58.83
950204701	P502047	Tank Sensor Assy	2	1	5	19.00
006228301		Light Rail Assy				
006225801		Prism Rail Assy	1	—	1	
006225901		Prism Rail Assembly				
950318501	P502590	Transfer Valve Assembly	1	—	1	
950299001	P502990	Fan Assembly	2	—	2	62.50
950299301	P502993	Solenoid, DC, Assembly	1	1	2	
950299901	P502999	Fan Assembly	2	1	4	112.00
950363701	P503637	Diode Mtg. Brkt. Assembly	1	1	3	69.00
950376601	B503766	Band, Precision	1	1	3	5.40